Chittagong Dry Dock Limited
Bangladesh Navy
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23.02.1565.341.39.002.25.422 04 June 2025

EXPRESSION OF INTEREST (EOI)

1. Chittagong Dry Dock Limited, Bangladesh Navy, East Patenga, Chattogram intends to participate in the tender related to Engineering, Procurement and Construction including Installation of Ship Docking and Repair Facility at Mongla to carry out docking, undocking, repair and maintenance of naval ships and crafts for the procuring entity as per enclosure. On that perspective, CDDL invites Expression of Interest (EOI) from reputed and eligible foreign partner to work in Joint Venture (JV). Proposed ship docking and repair facility will be capable of docking and undocking at least two ships of 120-meter length and 2500-ton lightweight throughout the year. Location of the ship docking and repair facility will be at Mongla, Digraj, Mongla, Bagerhat, Bangladesh, which is situated on the east bank of Pasur River. The life expectancy of the proposed ship docking and repair facility will be at least 100 years. The proposed ship docking and repair facility will be designed and constructed by an internationally reputed company in the mode of Engineering, Procurement and Construction (EPC) (including installation and commissioning) contract. Brief description of the project is as follows:

a. **Project Description.** Engineering, Procurement and Construction including Installation of Ship Docking and Repair Facility at Mongla.

b. **Quantity.** 01 (One) in number complete set.

2. **General Capabilities.**

a. Life expectancy of the ship docking and repair facility should be not less than 100 years.

b. Capable of docking and undocking of at least two naval ships of 120 m length and 2500-ton light ship displacement at a time. In addition, it should be able to dock and undock another ship of similar parameter for emergency repair.

3. **Standard.** The ship docking and repair facility shall be designed and constructed as per the specifications and standards set forth herewith and should be able to withstand severe weather conditions of construction location. Where no such standard/ specification is mentioned, it will have to be of highest naval standard.

4. **Scope of Supply.** Supply of a ship docking and repair facility as per tender specifications and hand over the total facility in ready to use condition. All machinery, equipment and accessories required for smooth operation of the facility have to be supplied, installed and commissioned in accordance with the tender specifications. General outline of the contractor's scope of supply and other responsibilities is described below.

5. **Technical Specification.** A complete technical specification of Ship Docking and Repair facility including specifications of machinery, equipment and systems and tender terms and conditions is enclosed herewith as "Enclosure-1". The foreign partner has to be submitted the offer fulfilling all the tender requirements as per "Enclosure-1".

6. **Qualification of Foreign Partner.** The foreign partner should have following qualification criteria (with sufficient documents as proof):

Chittagong Dry Dock Limited East Patenga, Chattogram. Bangladesh Navy

a. The foreign partner should have delivered/completed design, construction and procurement management of a slipway or similar marine structure (75m or more along the water front with minimum lifting capacity of 2500LWT) within last 15 (fifteen) years.

b. The foreign partner should have specific experience on design, construction and delivery of at least 1 (one) similar type successfully completed project with a value of at least Tk 500 (five hundred) crore (or equivalent in foreign currency). Or, similar two projects aggregating the same value within last 15 (fifteen) years.

c. The foreign partner should have average annual turnover greater than Tk 150 (one hundred fifty) crore (or equivalent in foreign currency) over the last 5 (five) years of best 5 (five) years in the last 7 (seven) years.

d. The foreign partner should have minimum amount of liquid asset or working capital or credit facilities amounting to Tk 200 (two hundred) crore (or equivalent foreign currency).

e. The foreign partner should have a local agency for communication.

7. **Submission of Offer/ Quotation.** The offer/quotation must include the following:

a. Complete technical specification of the offered Ship Docking and Repair facility including specifications of machinery, equipment and systems.

b. Compliance statement for the layout drawing of all facilities given in this specification. However, if there is any minor change offered, that is to be provided with a detail separate layout drawing.

c. Detail working procedure (including technical specification, drawings etc.) of the slipway and related ancillary systems and subsystems. However, alternate proposal may also be submitted (along with the type mentioned in this technical specification) in this regard with separate price schedule (please note the procedure for giving the financial offer).

d. Proof of eligibility and legal documents.

e. Summary of permanent professional employees with key qualifications.

f. Original certificates with regard to providing after sales warranty, guarantee for availability of spares and other services for complete package of supply.

8. **Compliance Statement.** A complete compliance statement fulfilling all the requirements of all equipment/ machinery as per technical specification is to be submitted with the offer.

9. **Delivery Schedule.** A Ship Docking and Repair Facility is to be constructed. The complete system is to be supplied, installed, and commissioned upon test/trial within 36 months from the date of signing the contract.

10. **Scope of Works of Foreign Partner.** Scope of Works of Foreign Partner will be as follows:

a. Maintain liaison with Procuring Entity and CDDL.

b. The Engineering, Procurement and Construction (EPC) including Installation and commissioning of Ship Docking and Repair Facility at Mongla in accordance with this

Chittagong Dry Dock Limited * East Patenga, Chattogram. * Bangladesh Navy

specification (Enclosure-1) with the consultation of BRTC, BUET or nominated personnel by BN.

c. To prepare detail layout drawing of the facility based on the layout drawing provided with this document.

d. To prepare drawing of all facilities (Repair Facility, Winch with control and power supply system, Slipway, Dolphin etc.) based on the technical specification and draft drawing provided with this document.

e. Foreign partner may execute the local works through a competent local company (proof of eligibility and legal documents to be submitted).

f. To prepare construction drawings of all civil works.

g. To procure, supply and install the machinery, equipment and facilities as per tender specifications.

h. FAT/ PSI (as applicable) of all the supplied items will be the responsibility of Foreign Partner.

j. Test and trial of all supplied machinery, equipment and systems.

k. Hand over the total facility in a ready-to-use condition. The Foreign Partner will also be responsible for supplying all items /equipment/ accessories related to the normal operation/function of the slipway (including docking and undocking operation of the targeted ships) whether it is mentioned in this specification/future contract or not.

l. Material, Equipment and Machinery package as per the Technical Specification (Enclosure-1) have to be supplied and installed at Mongla Naval Base designated area. In this regard, LC will be opened in the name of CDDL and Foreign Partner will bear all expenses related to LC Charges, LC Margin, LC amendment Cost, LC Confirmation Cost (if any), Marine insurance, C&F agent Commission, Port charges, Transportation cost, etc.

m. CDDL will issue BG in favor of client. Foreign partner will issue same amount Bank Guarantee (Performance Guarantee, Advance Payment Bank Guarantee, BG for Guarantee of Warranty etc.) in favour of CDDL through scheduled bank of Bangladesh.

n. All financial cost of CDDL (Tender security, Performance Guarantee, Advance Payment Guarantee, Bank Guarantee (if any), Bank guarantee for warranty, insurance for LC, etc.) to be borne by the Foreign Partner.

p. Financial offer has to be submitted in Local Currency (BDT). If the offer is submitted in Foreign Currency/ Dual Currency then the evaluation will be carried out in Local Currency with the conversion rate mentioned by the foreign partner. The offered price will remain fixed and firm.

q. During implementation of the project, if any Liquidated Damage (LD) is imposed on CDDL, the same will be imposed on the Foreign Partner.

r. Cost of Fuel oil, Lub oil, Grease, Coolant, etc. during test-trial and delivery will be borne by the Foreign Partner.

Chittagong Dry Dock Limited
East Patenga, Chittagong
Bangladesh Navy

s. All charges related to Boarding, Lodging, Feeding, Medical Support, transportation etc. of OEM Engineers/ Foreign Experts/ Foreign Partner will be borne by the Foreign Partner.

t. The price to be quoted as per guideline mentioned in Article 1.15 (Chapter-1) of "Enclosure-1"

u. Warranty of the project as per technical specification "Enclosure-1"

v. Any other expenses for successful completion, test trial and delivery of the project will be borne by the Foreign Partner.

11. **Scope of Works of CDDL.** Scope of works of CDDL will be as follows:

a. Maintain liaison with Procuring Entity and Foreign Partner.

b. Responsible for Bid bond as tender security.

c. Act as leading party to deliver the subject mentioned project executed by the Foreign Partner.

d. Will not have any types of investment throughout the project.

e. Will receive a service charge from the Foreign Partner.

f. Cradles and other steel structures (As applicable) manufacturing under supervision of Foreign Partner. Mentionable that, Foreign Partner will supply required drawings (Production Drawing, Nesting Drawing, etc.) and materials.

g. Site Clearing (Removal of trees, two causeway, old building demolish, taking approval from concerned authorities).

h. Furniture's of complex buildings (as per specification CW-05 of Enclosure-1).

j. Furnishing BG, PG, LC opening.

k. Materials transportation from Ctg/Mongla Port to Mongla Naval Base/ CDDL.

l. Associated costs of CDDL, for ser f, g, h, k above will be borne by foreign partner.

12. **Selection Criteria.** The participants are to submit both technical and financial offer in complete. The offers which will be technically suitable will be considered for financial selection process. However, company profile and earlier experiences will also be a prime factor to select the suitable Foreign Partner. Upon submission of complete documents, the final bidder (most responsive) will be selected based on both technical and financial offer.

13. **Site Visit.** Site visit must be conducted before 16 June 2025.

14. **Last date for Submission of offer.** 20 June 2025 at 1200 hrs BD time.

15. **Offer validity.** The offer should remain valid for 6 months.

16. Interested Foreign Partner will have to submit the offer with seal and sign by 20 June 2025 @12.00 PM at email: planning.cddl@gmail.com.

Chittagong Dry Dock Limited ★ Bangladesh Navy ★ East Patenga, Chattogram.

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17. Interested firm/ Contractor is hereby requested to contact following person of Planning & Estimates department of CDDL:

Sharif Md. Moheudden
Executive Engineer (Naval Architect)
OIC (Planning & Estimates)
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Chittagong Dry Dock Limited ★ East Patenga, Chattogram. ★ Bangladesh Navy

A HASANAT M AHMED
Captain BN
For Managing Director

Enclosures:

1. Technical specification and tender terms and conditions - 546 (Five Hundred Forty Six) Pages.
2. Drawings - 193 (One Hundred Ninety Three) Pages.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TENDER SPECIFICATIONS AND CONDITIONS

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

INTRODUCTION AND SCOPE OF SUPPLY

Document Code: A-01

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
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Dhaka 1000, Bangladesh

April 2025

Table of Contents

List of Abbreviations

AC	Air Conditioning, Alternating Current
ATS	Automatic Transfer Switch
BN	Bangladesh Navy
	Bangladesh Navy Ship
CCTV	Close Circuit Television
CNC	Computer Numerically Controlled
DC	Direct Current
EPC	Engineering, Procurement and Construction
FAT	Factory Acceptance Test
GIS	Gas Insulated Type
ICE	Internal Combustion Engine
LAN	Local Area Network
LP	Low Pressure
LWT	Lightweight
MDB	Master Distribution Board
MIG	Metal Inert Gas
MS	Mild Steel
MT	Marine Transport
PABX	Private Automatic Branch Exchange
PGCB	Power Grid Company of Bangladesh
PIT	Project Implementation Team
RC	Reinforce Concrete
SDB	Sub Distribution Board
TAN	Total Acid Number
TBN	Total Base Number
TIG	Tungsten Inert Gas

CHAPTER 1 INTRODUCTION

1.1 PREAMBLE

Bangladesh Navy (BN) intends to establish a complete Ship Docking and Repair Facility to carry out docking, undocking, repair and maintenance of naval ships and crafts. Proposed ship docking and repair facility will be capable of docking and undocking at least two ships of 120-meter length and 2500-ton lightweight throughout the year. Location of the ship docking and repair facility will be at Mongla, Digraj, Mongla, Bagerhat, Bangladesh, which is situated on the east the bank of Pasur River. The life expectancy of the proposed ship docking and repair facility will be at least 100 years. The proposed ship docking and repair facility will be designed and constructed by an internationally reputed company in the mode of Engineering, Procurement and Construction (EPC) (including installation and commissioning) contract.

1.2 LOCATION

Proposed ship docking and repair facility shall be constructed at Mongla. The site is located at the south west region of Bangladesh near the Mongla town under the Bagerhat district. Mongla is the 2nd busiest sea port of Bangladesh which is located near the Sundarbans. Location of Mongla may be seen on the map of Bangladesh as shown in Fig. 1.1. Closer details of the site MONGLA are shown in the satellite image of Mongla area in Fig. 1.2 and Fig. 1.3.

1.3 FUNCTIONS

The primary role of ship docking and repair facility shall be to dock and undock ships and crafts of BN in order to facilitate repair and maintenance of hull, machinery, equipment, armaments, sensors and systems of those ships. This facility will also be used for construction of small pontoons / barges / targets for BN. At the same time the facility may be needed for emergency repair works of any vessels owned by any government agencies of Bangladesh (especially the vessels of Bangladesh Coast Guard).

Fig. 1.1 Map of Bangladesh.

Fig. 1.2 Location of MONGLA

Fig. 1.3 Details of the proposed location at MONGLA

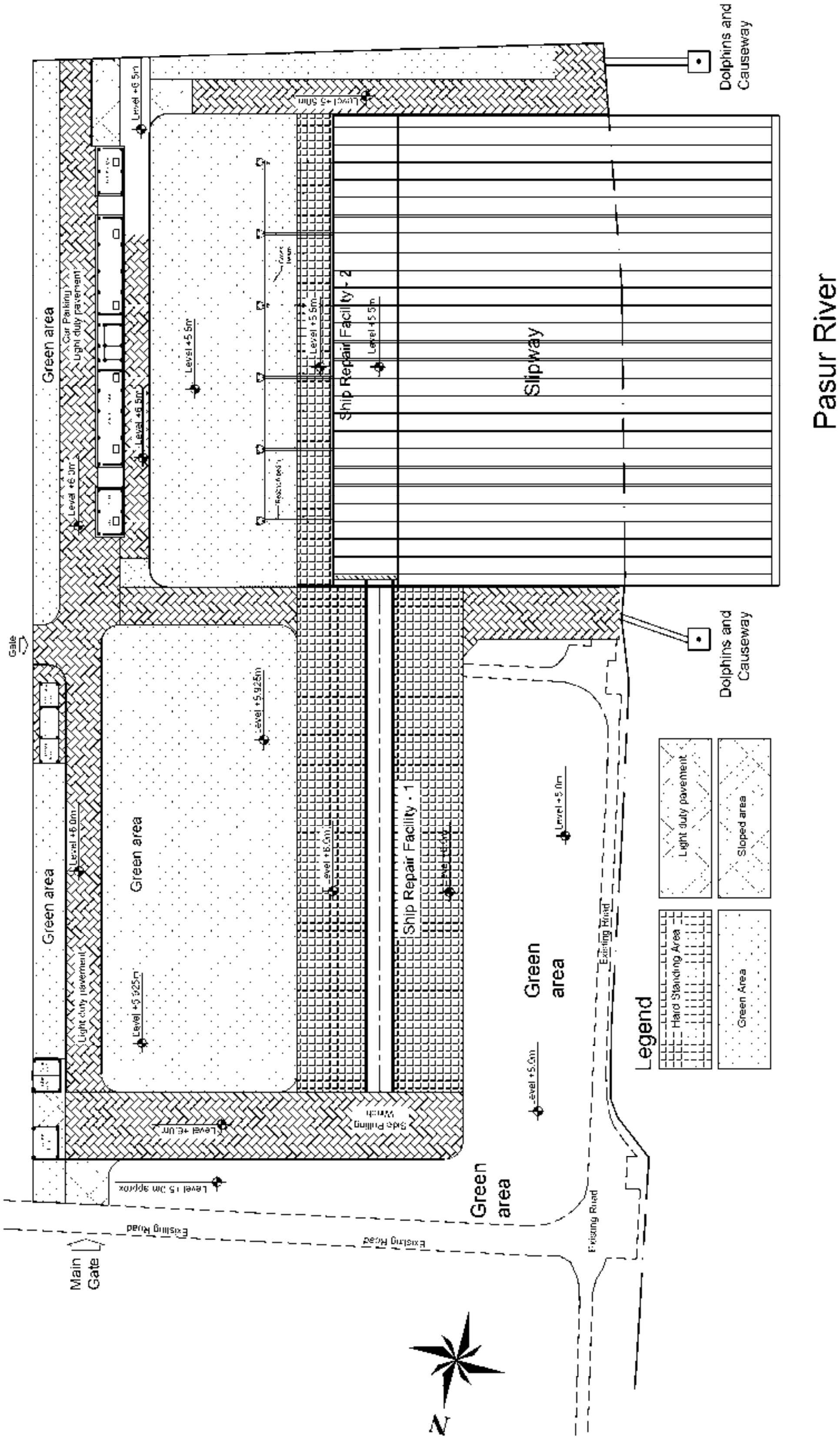

Fig. 1.4 Layout of the proposed facility.

1.4 GENERAL CAPABILITIES

a) Life expectancy of the ship docking and repair facility should be not less than 100 years.

b) Capable of docking and undocking of at least one naval ship of 120 m length and 2500 light weight ton ship displacement at a time. It should be able to dock and undock another ship of similar parameter for emergency repair.

1.5 STANDARD

The ship docking and repair facility shall be designed and constructed as per the specifications and standards set forth herewith and should be able to withstand severe weather conditions of construction location. Where no such standard / specification is mentioned, it will have to be of highest naval standard.

1.6 SCOPE OF SUPPLY

Bidder has to supply a ship docking and repair facility as per tender specifications and hand over the total facility in ready to use condition. All machinery, equipment and accessories required for smooth operation of the facility have to be supplied, installed and commissioned in accordance with the tender specifications. General outline of the contractor's scope of supply and other responsibilities is described below.

1.6.1 Machineries and Equipment to be supplied

Detailed list of machineries and equipment to be supplied are given separately as a part of tender documents. Material, machinery and equipment shall be selected as per the mentioned technical specification and also in such a way that the service and spares are readily available in Bangladesh to the most possible extent.

Construction of the foundation for the machineries (including all associated soil improvement and other works where required) shall also be considered as a part of the supply and installation of the machinery where necessary. All machineries shall be supplied with appropriate base isolation system where applicable, so that the impact and vibration from the machinery do not cause any short- or long-term damage to the floor and other structural and foundation system.

The test and trial of the machinery and equipment will be conducted in presence of supplier's representative (after installation). After satisfactory test and trial, an acceptance certificate will be signed between the supplier and the buyer.

Lists of machinery and equipment to be supplied are given below. Detail specifications of the machinery and equipment can be found in the provided documents with relevant specifications. The relevant File Code or Document Code are also listed in the tables below.

1.6.1.1 **Slipway Machinery**

Sl No.	Name	Qty.	Spec. File Code
1.	Slipway winch	Complete System	MS-01
2.	Marine Sheave Block Pulley	12	MS-01
3.	Marine Capstan	02	MS-01
4.	Marine Bollard	08	MS-01
5.	Heavy duty winch steel wire (hemp core type).	7200m (32mm dia)	MS-01
6.	Rail	3172 m	MS-01
7.	Slipway Cradle	Complete System	MS-01
8.	Emergency generator (3-phase, 2x300kVA, 400 V, with sound attenuated canopy and built in 1000Ampere ATS)	2	CW-04

1.6.1.2 **Repair Facility Machinery**

Sl No.	Name	Total Qty.	Spec. File Code
1.	Side Transfer Winch	01	MO-01N
2.	Marine Sheave Block Pulley	04	MO-01N
3.	Heavy duty winch steel wire (hemp core type).	1100m (28mm dia)	MO-01N
4.	Rail	1040m	MO-01N

1.6.1.3 **Dolphin Machinery**

Sl No.	Name	Total Qty.	Spec. File Code
1.	Marine Bollard	04	MO-02N
2.	Dolphin Fender	08	MO-02N
3.	Capstan	02	MO-02N

1.6.1.4 **Pump and Blasting System Machinery**

Sl No.	Name	Total Qty.	Spec. File Code
1.	Fire Pump (Diesel Engine Driven)	01	CW-04
2.	Fire Pump (Electric Motor Driven)	01	CW-04
3.	Jockey Pump (Pressure Maintenance Pump)	01	CW-04
4.	Air Compressor (Screw type)	02	MO-03N
5.	Hull Washing Pump	02	MO-03N

1.6.1.5 **Power Supply System Machinery**

Sl No.	Name	Total Qty.	Spec. File Code
1.	3-phase, 1500kVA, 11/.04kV Dry type Transformer	01	CW-04
2.	11kV HT Switchgear (VCB type)	01	CW-04
3.	Power Factor Improvement Unit	01	CW-04
4.	LT switchgear (2200A TPACB)	01	CW-04
5.	3c-240sq.mm HT NYSEYFGbY cable	As required	CW-04
6.	LT cables NYY, BYA type	As required	CW-04
7.	High Mast Light	06	CW-04

1.6.1.6 **Other Equipment (LAN, PABX, CCTV, High Mast Lighting)**

Sl No.	Name	Total Qty.	Spec. File Code
1.	24 port manageable network switch, Access network switch (8 port/ 24 port)	As required	CW-04
2.	64 port NVR	As required	CW-04
3.	PTZ camera	As required	CW-04
4.	Bullet type camera	As required	CW-04
5.	Dome type indoor camera	As required	CW-04
6.	Optical fiber (4-12 core), CAT6 LAN cable, Telephone pair cable, jelly filled copper cable	As required	CW-04

1.6.2 Installation of Facilities

1.6.2.1 Site Survey

The contractor is expected to carry out their own topographic and bathymetric survey as required.

1.6.2.2 Geotechnical Subsoil Investigation

The contractor is expected to conduct a thorough geotechnical subsoil investigation work to determine and verify the sub-soil geotechnical design parameters, pile and other foundation capacity, soil improvement parameters etc. for the foundation design of pavement, dolphin, slipway and other structures. The geotechnical investigation shall include, but not limited to, conducting Standard Penetration Test at required locations down to suitable depth, collection of disturbed and non-disturbed samples, visual classification of the soil, carrying out routine laboratory tests etc.

1.6.2.3 Clearing of Site and Establishing Site Offices

As a part of the work, the contractor shall demolish or relocate a few minor structures as appropriate. The contractor shall also construct and establish temporary site office buildings for their own as well as for the Engineer /Owner /PIT. The contractor shall also establish a temporary site laboratory to carry out routine tests of construction materials.

1.6.2.4 Installation of Slipway

Design and construction of a 131m wide slipway capable of side-docking and undocking naval vessels of max. length 120m, max. width 15m and max. weight 2500 ton (LWT) as per the suggested configuration and style.

The installation works shall include, but not limited to, reinforced concrete elements such as precast pile foundation, rail beams, cover slab, retaining wall, fitting and fixing of rails on rail beams, fixing of bollards and other equipment and elements as per the suggested design drawings. This item may also include construction of a temporary cofferdam (or a similar facility or methodology) of approved design in the river to dry up and protect the slipway area during installation.

1.6.2.5 Installation of Repair Facility

Design and construction of the Repair Facility to dock and repair two naval vessels, each of max length 120m, max width 15m and max weight 2500 ton (LWT) as per the suggested configuration and style.

1.6.2.5.1 Ground Preparation

Necessary preparation to improve the ground of the Repair Facility shall be carried out as per the provided drawings and specification.

1.6.2.5.2 RC Foundation and Structural Works

Construction and installation of pre-cast RC concrete piles, pile caps, short columns, grade slab, and slipway trolley rails with RC rail beams etc.

1.6.2.5.3 Plumbing and Drainage

Plumbing and drainage system shall be installed as per the requirement.

1.6.2.5.4 Electro-mechanical Works

Electro-mechanical works include all the required electrical underground cabling, installation of outdoor type shaded MDB and protective circuit breaker etc.

1.6.2.5.5 Fire Fighting

Installation of firefighting pillar hydrant system network for the Repair Facility as per standard requirement, which will be sufficient to carry out firefighting on board all the docked ships simultaneously.

1.6.2.6 Installation of Dolphin

Design and construct dolphins at the North and South side of Slipway with associated steel structure for causeway.

1.6.2.6.1 Foundation and Structure

The foundation of Dolphin involves installation of RC pre-cast driven piles along the shoreline of Pasur river in a rectangular array pattern. The dolphin platform shall be constructed as an RC slab rested on beams running over the top of piles in both directions.

1.6.2.6.2 Electro-mechanical Works

Electro-mechanical works include all the required surface type angle mounted electrical cabling and distribution box along the dolphin causeway.

1.6.2.6.3 Fenders,Capstans and Bollards

Fenders, capstans and bollards of required design and quantities shall be installed on the dolphins.

1.6.2.6.4 Steel Causeway

Steel causeway of 2m wide walkway and 23.5m span (approx.) adequate for pedestrian usage shall be constructed from the shore line to each of the dolphins for easy walking access to the dolphins.

1.6.2.7 Winch Control Facility

The winch with control system is planned and designed as a G+1 storied RC structure that shall house winch rooms, control room, power supply system and other facilities for the slipway docking and undocking operation.

1.6.2.7.1 General Arrangement Plan and Design

The structure shall be constructed in accordance with the general arrangement plan and design provided by the owner.

1.6.2.7.2 Ground Preparation

Necessary preparation to improve the ground for the Winch with Control and Power System shall be carried out as per the provided drawings and specifications.

1.6.2.7.3 Foundation and Structure

The construction shall be carried out with necessary foundation and structural works as per the provided drawings and specification (CW-01 and CW-02).

1.6.2.7.4 Common Utility Installation

Common utility installations should include installation of water supply pipes installation of drainage of rainwater as well as complete waste water and sanitary system as per the provided drawings and specifications.

1.6.2.7.5 Electro-mechanical Works

Electro-mechanical works include concealed conduit layout for electrical wiring, installation of MDB, SDB and protective circuit breaker as required, power electrical outlets and switches for electrical appliances, lights, fans, air-conditioners etc. as per the provided drawings and specifications.

1.6.2.7.6 11kV Substation

One 1500kVA, 11/0.4kV substation shall be installed including all the associated electrical and power equipment such as the 11kV 3-phase transformer, HT and LT switchgears (air-circuit breakers, current transformer, potential transformer, relays, micro-processor based network analyzer and metering equipment, surge protector of LT panel,

automatic reactive power control equipment with capacitor bank, 2 nos. 300 kVA diesel engine generator with ATS, auto synchronizer and sound attenuated canopy etc. for back up purpose. The installation shall include all the cabling, accessories, earthing system, cable trays and trenches etc.

1.6.2.7.7 Firefighting System

Sufficient number of firefighting portable extinguisher and fire detection control panel with fire alarm, smoke and heat detector at different locations etc. The firefighting hydrant system shall include installation of fire pillar hydrants for the whole structure as per the design and requirement.

1.6.2.7.8 Pump System

Diesel engine and electric motor-driven fire pumps and jockey pump having sufficient capacity shall be installed with electric control box, necessary valve, black steel pipe and fittings as part of fire hydrant system as per the tender document and requirement.

1.6.2.7.9 Finishing Works

The finishing works should include all the required items as specified in CW-02 document.

1.6.2.8 Security Monitoring System

This structure shall be constructed at eastern side of the Repair Facility as shown in general layout drawing. It is planned as a two storied RC structure that shall accommodate the Security Monitoring System.

1.6.2.8.1 General Arrangement Plan and Design

The structure shall be constructed in accordance with the General Arrangement plan and design provided by the owner.

1.6.2.8.2 Ground Preparation

Necessary preparation to improve the ground for the Security Monitoring System shall be carried out as per the provided drawings and specifications.

1.6.2.8.3 Foundation and Structure

The construction shall be carried out with necessary foundation and structural works as per the provided drawings and specifications (CW-01 and CW-02).

1.6.2.8.4 Common Utility Installation

Common utility installations should include installation of water supply pipes, installation of drainage of rainwater as well as complete wastewater and sanitary system as per the provided drawings and specifications.

1.6.2.8.5 Electro-mechanical Works

Electro-mechanical works include concealed conduit layout for electrical wiring, installation of MDB and SDB as required, protective circuit breaker, power electrical outlets and switches for electrical appliances, lights, fans, air-conditioners etc. as per the provided drawings and specifications.

1.6.2.8.6 Firefighting System

Sufficient number of firefighting portable extinguisher and fire detection control panel with fire alarm, smoke and heat detector at different locations etc. The firefighting hydrant system shall include installation of fire pillar hydrants for the structure as per the design and requirement.

1.6.2.8.7 Finishing Works

The finishing works should include all the required items as specified in CW-02 document.

1.6.2.9 Pump and Blasting System

This structure shall be constructed at the eastern side of the repair facility as shown in slipway general layout drawing. It is planned as a one-storied RC structure that shall accommodate the Pump and Blasting System.

1.6.2.9.1 General ArrangementPlan and Design

The structure shall be constructed in accordance with the General Arrangement plan and design provided by the owner.

1.6.2.9.2 Ground Preparation

Necessary preparation to improve the ground for the Pump and Blasting System shall be carried out as per the provided drawings and specifications.

1.6.2.9.3 Foundation and Structure

The construction shall be carried out with necessary foundation and structural works as per the provided drawings and specifications (CW-01 and CW-02).

1.6.2.9.4 Electro-mechanical Works

Electro-mechanical works include concealed conduit layout for electrical wiring, installation of MDB and SDB as required, protective circuit breaker, power electrical outlets and switches for electrical appliances, lights, fans, etc. as per the provided drawings and specification.

1.6.2.9.5 Firefighting System

Sufficient number of firefighting portable extinguisher and fire detection control panel with fire alarm, smoke and heat detector at different locations etc. The firefighting hydrant system shall include installation of fire pillar hydrants for the structure as per the design and requirement.

1.6.2.9.6 Pump System

Necessary units of pressure pump having sufficient capacity shall be installed with electric control box, nozzle, hose pipe, control valve, black steel pipe and fittings to wash ship's hull by 2/3 operators at the Repair Facility as per the tender document and requirement.

1.6.2.9.7 Sand Blasting System

A complete fixed type sand blasting system for four simultaneous sand blasting operations at the Repair Facility shall be provided with an appropriate number of compressors, sand reservoir and necessary piping arrangements.

1.6.2.9.8 Finishing Works

The finishing works should include all the required items as specified in CW-02 document.

1.6.2.10 Hard Standing Area (Rigid Pavement)

Reinforced concrete rigid pavement, both heavy duty (hard standing area) and light duty types shall be constructed at various locations of project as shown on the drawings.

1.6.2.10.1 Structural Construction

The work includes improvement of the existing soil by removing the 0.5m deep loose top soil, installing closely spaced 7.0m long sand compaction piles by soil displacement method, sub grade filling by compacted fill material, improved sub base fill and then casting an RC pavement slab and RC wearing course with finished top at level +6.0m or +6.5m as

appropriate, all as per supplied design and drawings. Areas where RC pavement is not constructed, shall be filled with compacted fill material up to +6.00m level (Chart Datum).

1.6.2.10.2 Drainage (U-Drain)

A drainage system consisting of RC U-drain of width 0.45m and depth ranging from 0.45m to 1.2m, with appropriate cover slab at some locations, constructed on the edges of the hard standing area (RC pavement) and at other locations as per the design drawings and specifications.

1.6.2.10.3 Electrical/Utility Works

Electrical/utility works of the pavement include installation of underground pipe/conduits with inspection pits at suitable intervals for electrical and other cabling over the whole premises as per the supplied design drawings. The work also includes erection of several 30m high mast lighting system for the whole project area.

1.6.2.11 Auxiliary Items for Administrative Works

Various items are to be provided to facilitate the administrative works of the Ship Docking and Repair Facility operations. Items to be provided as per the specifications mentioned in CW-05.

1.6.2.12 CCTV Surveillance, LAN/Internet and PABX System

The whole facility shall be under a CCTV surveillance system. Local area networking (LAN) for internet connectivity shall be there at all structures as per the design. An internal PABX system shall be installed as specified. Necessary details are given in drawings and specifications.

1.6.2.13 Quantity of Supply

The quantity of supply for all constructions shall be in accordance with the scope of supply described in the preceding articles of this Section 1.6 as well as those shown on the drawings as included in this tender document (see Sections 1.7and1.11).

1.7 TECHNICAL SPECIFICATION DOCUMENTS AND ENGINEERING DRAWINGS FOR INSTALLATION WORKS

The required technical specifications and a set of basic design drawings for the installation works are included as part of this tender document. Following table summarizes the list.

Item of Supply /Works	Sub-item	Drawing File Ref.	Specification Document Ref. or Document Code
Site Survey		02.A	
Geotechnical Subsoil Investigation			A-03
Design and Construction of Slipway	Foundation	04.A	CW-01, CW-02
	Rail Beams and RC Cover	04.A	CW-01, CW-02
	Retaining Walls	04.A	CW-01, CW-02
	Cradle, Trolleys	04.B	CW-02
	Rail Section	04.C	CW-01, CW-02
Design and Construction of Repair Facility	Foundation	05.A	CW-01, CW-02
	RC Floor	05.A	CW-01, CW-02
	Electro-mechanical	11.C	CW-04
Design and Construction of Dolphins	Foundation	06.A	CW-02
	RC Part	06.A	CW-02
	Electro-mechanical	11.C	CW-04
Design and Construction of Winch Control Facility	Architectural	07.A	CW-01
	Foundation	07.B	CW-01, CW-02
	RC structure	07.B	CW-01, CW-02
	Plumbing, Sanitary, Drainage	07.D	CW-03
	Electro-mechanical	07.C	CW-04
	Fire, CCTV, Telecom etc.	07.E	CW-04
	Auxiliary Items		CW-05
Design and Installation of Hard Standing Area	Architectural	11.A	
	Foundation	11.B	CW-01, CW-02
	RC structure	11.B	CW-01, CW-02
	Plumbing, Sanitary, Drainage	11.D	CW-01, CW-03
	Electro-mechanical	11.C	CW-04
	Fire, CCTV, Telecom etc.	11.C	CW-04
Design and Construction of Security Monitoring System, and Pump and Blasting System	Architectural	08.A	CW-01
	Foundation	08.B	CW-01, CW-02
	RC structure	08.B	CW-01, CW-02
	Plumbing, Sanitary, Drainage	08.D	CW-03
	Electro-mechanical	08.C	CW-04
	Auxiliary Items	08.A	CW-05
Design and Construction of Generator, Electro-mechanical and Fire pump Room	Architectural	12.A	CW-01
	Foundation	12.B	CW-01, CW-02
	RC structure	12.B	CW-01, CW-02
	Electro-mechanical	12.C	CW-04
	Auxiliary Items		CW-05

1.8 AMBIENT CONDITIONS

a) Air Temperature : +05ºC to +50ºC.

b) Relative Humidity : Up to 95%.

c) High Mud (suspended) Content in Adjacent River.

d) Salinity : 30-34 ppm

e) Reference Levels : CD = PWD + 1.2m

1.9 PRINCIPAL DIMENSIONS

a) Site Area: Approximately 56928 m^2

b) Slipway: 131 m ×122 m

c) Repair Facility: 46 m× 130 m

d) Dolphin: as per drawing

e) Winch Control Facility: 8.2 m × 109 m

1.10 CERTIFICATION

Following certificates shall be provided before acceptance-

a) Load capacity certificate for slipway.

b) Load certificate of the structures.

c) Load certificate of hard standing space.

d) Load certificate of dolphin.

e) FAT certificate for all major machinery and equipment

1.11 LIST OF DOCUMENTS AND DRAWINGS

The lists of documents provided with this tender are listed below.

1.11.1 Product Information, Terms and Conditions

Sl.	Document Code	Document Title /Description	File Name
1	A-01	Introduction and Scope of Supply	A-01. Introduction and Scope– R1.pdf
2	A-02	Terms and Conditions	A-02. Terms and Conditions– R1.pdf
3	A-03	Geotechnical Investigation Report	A-03. BNS MONGLA_Geotechnical Report– R1.pdf
4	A-04	Hydro-Morphological Study	A-04. Hydro-Morphological Study BNS MONGLA 04-01-2022– R1.pdf
5	A-05	River Flow Modeling (Pasur) for Impact Analysis and Mitigation Plan to Set Up “Ships Docking and Repair Facility” at Mongla (Draft Final Report).	A-05. IWM River Flow Modeling (Draft) – R1.pdf

1.11.2 Technical Specification of for Design and Construction of Facilities

Sl.	Document Code	Document Title/Description	File Name
1	CW-01	Technical Specifications for General Arrangement and Engineering Design of Facilities	CW-01. General Arrangement and Engineering Design of Facilities Spec-R1.pdf
2	CW-02	Technical Specifications for Facilities Installation and Commissioning Part-1 of 2	CW-02. Facilities Installation and Commissioning Specification Part-1 of 2 - R1.pdf
3	CW-03	Technical Specifications for Facilities Installation and Commissioning Part-2 of 2	CW-03. Facilities Installation and Commissioning Specification Part-2 of 2 - R1.pdf
4	CW-04	Technical Specifications for Internal Electrification, Distribution Substation, Emergency Generator, Air Conditioning, Fire Detection and Fire Hydrant System, Security Surveillance CCTV System, LAN/Internet etc.	CW-04. Electromechanical Substation Generator AC CCTV LAN etc - R1.pdf
5	CW-05	Technical Specifications for Auxiliary Items for Administrative Works	CW-05. Auxiliary Items for Administrative Works - R1.pdf

1.11.3 Detailed Technical Specification for Machinery and Equipment

Slipway Machinery

Document Code	**File Name**
MS-00	MS-00. Slipway Machinery and Cradle -R1.pdf
MS-01	MS-01. Slipway Machinery Spec – R1.pdf

Other Machinery and Equipment

Document Code	**File Name**
MO-00	MO-00. Shipyard Other Machinery List -R1.pdf
MO-01N	MO-01N. Repair Facility Machinery-R1.pdf
MO-02N	MO-02N. Dolphin Machinery-R1.pdf
MO-03N	MO-03N. Pump and Blasting System Machinery – R1.pdf

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TERMS AND CONDITIONS

Document Code: A-02

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

Table of Contents

List of Abbreviations

AC	Alternating Current, Air Conditioner
ATS	Automatic Transfer Switch
BG	Bank Guarantee
BN	Bangladesh Navy
BNS	Bangladesh Naval Ship
BNBC	Bangladesh National Building Code 2020
BOQ	Bill of Quantities
BRTC	Bureau of Research, Testing and Consultation
BUET	Bangladesh University of Engineering and Technology
CCTV	Close Circuit Television
CNC	Computer Numerically Controlled
DC	Direct Current
DGDP	Directorate General Defense Purchase
EPC	Engineering, Procurement and Construction
FAT	Factory Acceptance Test
GIS	Gas Insulated Type
ICE	Internal Combustion Engine
JV	Joint Venture
LAN	Local Area Network
LD	Liquidated Damages
LP	Low Pressure
LWT	Light Weight Tonne
MDB	Master Distribution Board
MIG	Metal Inert Gas
MT	Marine Transport

NBR	National Board of Revenue
NSSD	Naval Store Sub Depot
PABX	Private Automatic Brach Exchange
PG	Performance Guarantee
PGCB	Power Grid Company of Bangladesh
PIT	Project Implementation team
PSI	Pre-Shipment Inspection
RC	Reinforced Concrete
SDB	Sub-distribution Board
TAN	Total Acid Number
TBN	Total Base Number
TIG	Tungsten Inert Gas

CHAPTER 1 TERMS AND CONDITIONS

1.1 QUALIFICATION OF THE BIDDER

a. Bidder should be a DGDP enlisted local (Bangladeshi) shipyard/dockyard having experience of operating and maintaining a slipway for last 12 (twelve) years and capacity of shipbuilding and repair of naval/coastguard vessels through docking and undocking.

b. The bidder should have experience of docking/launching and repair of at least 10 (ten) warships in the last 5 (five) years through own slipway or similar facility.

c. Bidder may have his foreign partner in completing the project. In this case, the responsibility of the bidder and his partner are to be clearly stated.

d. In addition to the above, bidder or his foreign partner should have following qualification criteria (with sufficient documents as proof):

   i. Either bidder or his foreign partner should have delivered/completed design, construction and procurement management of a slipway or similar marine structure (75m or more along the water-front with minimum lifting capacity of 2500 LWT) within last 15 (fifteen) years.

   ii. Either bidder or his foreign partner should have specific experience on design, construction and delivery of at least 1 (one) similar type successfully completed project with a value of at least Tk 500 (five hundred) crore (or equivalent in foreign currency). Or, similar two projects aggregating the same value within last 15 (fifteen) years.

   iii. Either bidder or his foreign partner should have average annual turnover greater than Tk 150 (one hundred fifty) crore (or equivalent in foreign currency) over the last 5 (five) years or best 5 (five) years in the last 7 (seven) years.

iv. Either bidder or his foreign partner should have minimum amount of liquid asset or working capital or credit facilities amounting to Tk 200 (two hundred) crore (or equivalent foreign currency).

e. The bidder shall have experience of at least 02 in number civil construction contracts each having a minimum value of Tk 100 (one hundred) crore within last 12 (twelve) years.

1.2 RESPONSIBILITIES OF THE PARTIES INVOLVED

a) Bangladesh Navy (BN): The responsibilities of BN shall be as follows

i. To approve appropriate offer proposed by the firm (in consultation with the appointed consultancy firm, ie. in this case, Bureau of Research, Testing and Consultancy (in short, BRTC) of Bangladesh University of Engineering and Technology (in short, BUET).

ii. To employ a Project Implementation Team (PIT) at the construction premises.

iii. To employ FAT and PSI team(s) as mentioned in the specification.

iv. To approve layout drawing, detail drawing and construction drawing of all facilities (Repair Facility, Winch with control and power supply system, Slipway, Dolphin etc.) as regard to production.

v. To overview, support and assist test and trial of all machinery, equipment and systems.

b) The Bidder or his partner: The Bidder or his partner shall be responsible for the following:

i. The Engineering, Procurement and Construction (EPC) including installation and commissioning of the Ship Docking and Repair Facility at Mongla in accordance with this specification (or the contract which will be signed between the bidder/bidder and the Government of Bangladesh (represented by Director General of Defense Purchase or DGDP) once signed) with the consultation of BRTC, BUET or nominated personnel by BN.

ii. To prepare detail layout drawing of the facility based on the layout drawing provided with this document.

iii. To prepare drawing of all facilities (Repair Facility, Winch with control and power supply system, Slipway, Dolphin etc.) based on the technical specification and draft drawing provided with this document.

iv. To prepare construction drawings of all civil works.

v. To procure, supply and install the machinery, equipment and facilities as per tender specifications.

vi. Test and trial of all supplied machinery, equipment and systems.

vii. Hand over the total facility in a ready-to-use condition. The bidder will also be responsible for supplying all items /equipment/ accessories related to the normal operation/function of the slipway (including docking and undocking operation of the targeted ships) whether it is mentioned in this specification/ future contract or not.

1.3 SUBMISSION OF OFFER/ QUOTATION

The offer/ quotation must include the following:

a) Complete technical specification of the offered Ship Docking and Repair facility including specifications of machinery, equipment and systems.

b) Compliance statement for the layout drawing of all facilities given in this specification. However, if there is any minor change offered, that is to be provided with a detail separate layout drawing.

c) Detail working procedure (including technical specification, drawings etc.) of the slipway and related ancillary systems and subsystems. However, alternate proposal may also be submitted (along with the type mentioned in this technical specification) in this regard with separate price schedule (please note the procedure for giving the financial offer).

d) Name of the bidder's firm/ lead firm and associated firms forming the joint ventures or association with address and particulars.

e) Registration of the bidder's firm.

f) Proof of eligibility.

g) Summary of permanent professional employees with key qualifications.

h) Original certificates with regard to providing after sales warranty, guarantee for availability of spares and other services for complete package of supply.

1.4 DESIGN RESPONSIBILITY OF THE BIDDER

The Bidder shall be deemed to have scrutinized, prior to the submission of bid, the obligations and the Employer's/Owner's requirements (including design criteria and calculations, if any). The bidder shall be solely and fully responsible for the engineering design of the temporary and permanent works (e.g. Repair Facility, Winch Control and Power Supply System, Slipway, Dolphin etc. including those not shown on the drawings) and for the accuracy of design calculations and drawings of such Employer's/Owner's requirements. In preparing the design of structures and other facilities having design components such as, but not limited to, foundation, structural, plumbing and sanitary, electro-mechanical, fire detection and firefighting, CCTV surveillance system, PABX system, LAN and internet networking and communication system, electric substation, generator, air-conditioning, pavements etc., provisions of Bangladesh National Building Code 2020 (BNBC 2020) shall be applicable with technical data and information provided elsewhere in this tender document and drawings. In addition, other standard international codes as accepted and approved by the Owner/Employer may also be used wherever needed to supplement BNBC 2020.

1.5 PREPARATION OF DESIGN AND WORKING DRAWINGS

The design drawings supplied as part of the tender document constitute a basic design of the proposed facility and are provided to assist the bidder in understanding the nature and extent of the works and supply items covered in this tender. The bidder/bidder must carry out their own design calculations and prepare detailed or shop/fabrication drawings for the Slipway, Cradle, Repair Facility, Dolphins, different structures including those not shown on the drawings, electric substations, pavement and other facilities based on the drawings provided in the tender documents. The contractor shall also perform necessary design calculations and prepare drawings of all the temporary structures, e.g. cofferdam, formworks, access stairs and ladders, and other temporary facilities and have them approved by the owner/buyer. It may be noted that the bidder may make changes in the design and detailing of the items, provided that the general concept and scope of the design as demonstrated in the tender drawings are not changed. Also such changes shall not cause in any change in the bid price or contract value.

The bidder/bidder shall perform their own analysis and design calculations (as indicated in Sec 1.4) and prepare detailed shop/fabrication drawings based on their own analysis. In such a case, the analysis and design calculations must be in accordance with the technical specifications (document code CW-01, CW-02, CW-03, CW-04 etc.) which are provided as

part of this tender document. In any case, the bidder may not change any architectural layout, plan or feature of the structures such as the location of the proposed facility, floor plans, column locations, locations of stairs, floor height, room arrangements, interior and exterior architectural design features etc. The bidder shall also submit detailed design calculation report with each item thus designed. Design of the structures thus performed by the bidder must be approved by the Engineer/PIT before being adopted for construction.

1.6 INSTALLATION SCHEDULE/ PROGRAMME

Before signing the contract with the buyer (BN), the bidder shall prepare and submit an installation program/schedule to the buyer (BN) for approval showing the events (installation works) and successive sub-events including all the management and control parameters like Earliest Start Time (EST), Earliest Finish Time (EFT), float events on critical path, etc. with description of general method of works, in orderly manner all in the form of network diagram and Gantt chart prepared in computer software like MS project/Primavera and presenting in displayable hard and soft copy. This item must be available and agreed upon before the actual signing of the contract.

1.7 MONTHLY PROGRESS REPORT

Monthly Progress Reports shall be submitted by the bidder/bidder in printed and bound form for every calendar month with actual data of installation and other works done and further planning of work on the basis of actual scenario of the project. The report shall include the following.

a. General description of works and other activities done in the month.

b. Copies of test reports.

c. Copies of site order book.

d. Copies of all letters, communications and emails issued in the month relevant to the project.

e. Copies of minutes of all the site meetings that took place in the month.

f. Inventory of items entered into the construction site and the amount/quantity used in the installation/construction of different items, components and sub-components in the month.

g. Color photographs of the important installation activities carried out in the month with date and proper caption. Size of the photographs shall be 150mm x 100mm and to be printed on ordinary offset white paper for inclusion in the monthly report. There shall be at least 20 (twenty) photographs for every month.

h. Bar graph showing the actual progress of work in comparison to the previously approved project bar chart.

i. Minutes of quarterly progress meeting.

j. Detail drawings of any new/changed/revised item(s).

k. Any other information that may seem to be important.

At least 05 (five) printed copies (in color) of the monthly progress report in a properly bound format shall be submitted to the Owner. In addition, soft/electronic copy of the report in portable document format (PDF) shall also be submitted to the owner.

1.8 PROGRESS MEETING

The bidder shall, as a minimum, arrange quarterly progress meeting between their authorized representatives, owner/employer's representatives and the consultant's representatives at the PIT's office at site. The bidder shall present detailed progress of works in the meeting. Monthly Progress Reports of the past three months shall primarily form the basis of discussion in the meeting. In addition, other important topics shall also be discussed. The meeting agenda shall be prepared and prior approved by the owner. A notice of the meeting shall be served sufficient days ahead of the actual scheduled date of the meeting. Based on the discussion and decision taken in the meeting, a Minutes of the Meeting shall be prepared within next seven days and accepted by the bidder and approved by the Owner. The bidder shall bear all the cost of conducting the meetings.

1.9 AS-BUILT DRAWINGS

The bidder shall provide 03 (three) sets of as-built Drawings (Structural, Architectural, Plumbing and Sanitary, Fire Detection and Fighting, Electrical and Mechanical, Air Conditioning System, Substation and Generator, Telephone/Intercom/PABX, LAN/Internet and CCTV Networking System and all other items supplied) subject to Owner's approval produced in AutoCAD software in ISO A3 (420mm x 297 mm) standard drawing paper, and operating and maintenance manual of all the equipment and plants (e.g. Ship docking, berthing and un-docking operations, Pumps, Generators, Substations, Fire detection and

Firefighting system and other supplied systems and components etc.) included in the scope of supply in original within three months of the completion, commissioning and acceptance of all the items to be supplied as per contract. The relevant AutoCAD drawings files and other computer software files and portable document format (PDF) files of the drawings and documents shall also be supplied on CD/DVD in three copies. The as-built drawings must show the permanent works as actually installed and reflect the revision of Tender Drawings and Drawings supplied to the Bidder/bidder during the Contract as well as revisions of drawings supplied by the Bidder/bidder during the Contract.

1.10 SAFETY MANAGEMENT SYSTEM

The bidder shall prepare Safety Plans for the installation works showing the Bidder/bidder's proposed health and safety management policies, systems and plans specifically prepared for all the items to be supplied and installed. The Safety Plans shall set out or refer to all the health and safety requirements outlined in the Bangladesh Labor Acts and Rules as well as the Bangladesh National Building Code 2020. The Safety Plans shall ultimately provide an accurate and comprehensive description of the Bidder/bidder's arrangements to ensure that health and safety management of all the workers and other personnel is maintained at a high level. Submission of any Safety Plan and inclusion in the Bid or Contract or any further submission to the Owner, shall not place any limit upon the bidder's obligations. Any additional requirements as determined by the Contract or consequent to instructions of the owner/buyer or by requirements at the site, shall be complied with by the bidder under his own responsibility.

1.11 PROJECT IMPLEMENTATION TEAM (PIT)

A Project Implementation Team (PIT) shall be employed by BN which will supervise /monitor along with the appointed constant team during the construction period. The PIT will be formed and nominated by BN. All costs related to the PIT and the consultant team will be borne by BN. However, an office facility inside the site will be provided by the bidder as outlined in detail in the contract specifications.

1.12 FACTORY ACCEPTANCE TEST (FAT) AND PRE-SHIPMENT INSPECTION (PSI)

a. FAT/PSI will be carried out for all major machinery and equipment in the factory premises. The items of FAT/PSI will include (but not be limited to) Slipway winch system, Sheave Block Pulley, Generator sets, steel plates (for Cradles), rails etc.

Buyer's representative (from BN and Consultant) will be present during the FAT/PSIs. Each of such FAT and PSI teams will consist of 04 (four) personnel nominated by the buyer/owner (BN).

b. For BN team, all costs related to FAT/PSI including local transportation (air/sea/road/rail) within the manufacturer/bidder's country, reception and arrangement for entry into country/concerned area for FAT and PSI shall be quoted and borne by the bidder. International airfare, messing, accommodation and daily allowances shall be borne by BN. However, for the representative of the consultant, all costs related to international airfare, messing, accommodation and local transportation within the manufacturer/bidder's country shall be quoted and borne by the bidder.

1.13 SUPERVISION AND INSPECTION

A team of buyer's representatives shall visit the construction area time to time. The representatives shall have full authority to inspect the construction work to satisfy themselves by any reasonable means they may deem fit to see that materials and workmanship conform to the requirements of the specifications.

1.14 ORIENTATION AND TRAINING

The bidder shall arrange sufficient orientation and training of BN-recommended personnel at the installation site for at least 02 weeks within the quoted price. The training should cover all aspects of operation and maintenance of all machinery, equipment, and systems in general (including special requirements, if any, as mentioned in the technical specification of the particular equipment/system). Detail aspects of training (including duration, scope etc.) are to be mentioned with the offer.

1.15 BID PRICE

The price is to be quoted in local currency and is to be broken down into the components mentioned below, from where BN will have the option to choose the whole or part of any component.

a) Price of design package including all design, drawings, etc.

b) Price of slipway construction and commissioning.

c) Price of Repair Facility.

d) Price of all structures individually (Winch with Control and Power Supply System, Security Monitoring System, and Pump and Blasting System).

e) Price of all machinery equipment.

f) Price of dolphin (including causeway) construction.

g) Price of pavements in open spaces as per layout drawing.

h) Cost of FAT and PSI.

i) Cost of orientation training on operation and maintenance.

j) Cost of test and trial is to be included with the price of respective items/systems.

k) Bidder is to quote all prices considering the layout and concept of the provided design. This price will be used for tender evaluation and price comparison. However, Bidder may offer alternative proposals (along with the offer in accordance with this specification) forthe slipway system with separate price.

l) Any other charges.

1.16 DELIVERY SCHEDULE

A Ship Docking and Repair Facility is to be constructed. The complete system is to be supplied, installed, and commissioned upon test/trial within 36 months from the date of signing the contract between BN and the Bidder.

1.17 LEGAL AND FINANCIAL ISSUES

All legal and financial issues mentioned in this specification are to be fully complied/ agreed by the bidder. BN shall have the right to cancel the bid if any condition is not agreed upon by the bidder during the process of evaluation and negotiation in finalizing the contract specification. Besides, all legal issues shall be governed by procurement regulations of Bangladesh Armed Forces.

1.18 ARTICLE WISE COMPLIANCE SHEET

Article wise compliance on the buyer's Technical Specification is to be provided. The bidder should clearly mention whether it complies with the requirements of the buyer mentioned in various articles of the tender specification or not. Any deviation must be clearly stated in the offer.

1.19 PAYMENT SCHEDULE

100% of the Total Contract Price (TCP) shall be made in local currency. The payment schedule shall be as follows:

1.	a. On submission of general layout plan, basic design (Ship Docking and Repair Facility) and on submission of BG (10% of TCP value) and upon receipt of Certificate issued by NHQ, BN.	10% of the TCP
	b. On mobilization of resources (namely dredger, barge, testing elements, drilling rig, establishment of site office, water supply and electrical connectivity etc.) at the site detail production drawing of the ship docking & repair facility and on submission of BG (10% of TCP value) and upon receipt of Certificate issued by NHQ, BN.	10% of the TCP
2.	a. Construction of cofferdam, arrival of all steel material of the cradle for the Repair Facility and slipway, submission of the proof of purchase order for all major machineries for slipway and upon receipt of Certificate issued by NHQ, BN.	15% of the TCP
	b. On completion of all necessary works for foundation of slipway and winch with control and power supply system and upon receipt of Certificate issued by NHQ, BN.	15% of the TCP
3.	a. On completion of total works of all structures, Repair Facility, slipway and dolphin with causeway and upon receipt of Certificate issued by NHQ, BN.	15% of the TCP
	b. On arrival of all major machineries and equipment (capstans, winches, generator, slipway cradle items, rails etc.) at site and upon receipt of Certificate issued by NHQ, BN.	15% of the TCP
4.	On completion of 100% of contracted works and final acceptance by BN and upon furnishing a bank guarantee for warranty equivalent to 5% of TCP value of the contract.	20% of the TCP

1.20 BANK GUARANTEES

1.20.1 Performance Guarantee (PG)/ Bond

The Bidder shall have to provide, before signing the contract, a performance guarantee for an amount equivalent to 10% of the TCP value of the contract from any Scheduled Bank in Bangladesh in favor of **Senior Finance Controller (Navy) [SFC(Navy)], Lalasari, Sailors' Colony, Mirpur 14, Dhaka-1206, Bangladesh**. This Performance guarantee shall be valid till satisfactory test, trial and final acceptance of Ship Docking and Repair Facility. The PG will be released upon receipt of final acceptance certificate issued by BN and on submission of Guaranty for Warranty as stated in the next paragraph.

1.20.2 Modality

The bidder shall furnish a Bank Guarantee (BG) of an amount equivalent to 10% (ten percent) of the TCP value before the payment for package mentioned in 1(a) of Payment Schedule. Similarly, 10% (ten percent) of the TCP value is to be furnished before the payment for the package mentioned in 1(b) of Payment Schedule. The BG will be released upon the delivery of the package mentioned in serial 2 of Payment Schedule.

1.20.3 Guarantee for Warranty

The Bidder shall furnish to DGDP a bank guarantee for warranty after satisfactory completion of total contracted works an amount equivalent to 5% (five percent) of the TCP value of the contract which shall remain valid until expiry date of the warranty period.

1.21 SPECIAL CONDITIONS

The defense stores listed in the Ministry of Finance, The Government of the Peoples' Republic of Bangladesh (NBR Memo No 9 (41) NBR/Cus-IV/72/246 dated 10 Apr 1981) are exempted from the payment of custom duties and taxes. The price quotations are to be made accordingly considering those customs and tax exemption.

1.22 VALIDITY OF OFFER

Six (06) months from date of submission of offer.

1.23 DELAYED DELIVERY

As per DGDP rule.

1.24 FORCE MAJEURE

As per DGDP rule.

1.25 OMISSION

In case the bidder fails to supply/provide any of the items (i.e. machinery, equipment, facility, system etc.) within the scope of supply of the contract, the contract price shall be adjusted by deducting the quoted price of the item along with 25% penalty based on the quoted price of the item. If the price of the item is not quoted in the original offer, BN shall have the right to determine the price of the item based on procurement price of similar item by the BN through DGDP/NSSD, Dhaka or any other means. However, if the omission/correction is made under mutual agreement between the buyer and bidder, no penalty will be made.

1.26 ARBITRATION

As per DGDP rule.

1.27 CONDITION FOR ACCEPTANCE OF QUOTATION.

Quotation has to have supported documents (all required certificates as mentioned before, booklets, leaflet, catalogue, brochure etc) having detailed particulars of the intended item, it's machinery, equipment, fittings, fixtures, accessories, spare parts etc. If detailed information regarding intended item and its machinery, equipment, fittings, fixtures, accessories, spare parts etc. are not provided; the quotation will not be accepted.

1.28 BILL OF QUANTITIES (BOQ)

No BoQ will be provided by the buyer. The bidder will prepare BoQ at their own, which shall be based on the developed drawings and as-built drawings on which the bidder will be required to execute.

1.29 PRE-BID MEETING

Pre-bid meeting may be arranged if any request from potential bidder is received well in time.

1.30 SITE SURVEY

The bidder may visit the site for survey. A proposal has to be sent to NHQ (DNE) is this regard beforehand for necessary formalities.

1.31 WARRANTY

The warranty time for the complete system will be 12 months from the date of acceptance by BN.

1.32 FINAL TEST & TRIAL AND ACCEPTANCE:

The final test and trial will be carried out by docking 02 ships (frigate class) on the Repair Facility and 01 ship (frigate class) on the slipway simultaneously. Upon completion of the satisfactory test and trial, the representatives of the bidder and BN will sign a certificate jointly. After both parties sign the certificate, BN will issue the final acceptance.

1.33 VARIATION

Minor variations in the design and construction of structures may be allowed based on mutual agreement between the buyer and the bidder, and within the fixed price mentioned in the contract.

1.34 PORT OF SHIPMENT

In general port of shipment of the items will be any port of the manufacturing country. However, items may be shipped from any other port if sufficient reason is there.

1.35 MATERIAL OWNERSHIP

The contractor/bidder shall not take out or take away any material, product, machinery or equipment (old/new, imported or previously existed on site) out of the project area or out of BNS MONGLA premises without the prior permission of the owner/buyer.

1.36 PART SHIPMENT AND TRANSSHIPMENT

Allowed.

1.37 CONSIGNEE

a. For importing items by sea:

The Commanding Officer, Naval Stores Depot, New Mooring, Chattogram, Bangladesh

or

The Officer In-Charge, Naval Stores Depot, Khalishpur, Khulna, Bangladesh.

b. For importing items by air:

The Officer In-Charge, Naval Stores Sub Depot, Dhaka, Khilkhet Naval Area, Namapara, Khilkhet, Dhaka-1229, Bangladesh.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

Machinery and Equipment to be Supplied

Document List:

MS-00 List of Slipway Machinery
MS-01 Technical Specifications for Slipway Machinery
MO-00 List of Slipway Other Machineries
MO-01N Technical Specifications for Repair Facility Machinery
MO-02N Technical Specifications for Dolphin Machinery
MO-03N Technical Specifications for Pump and Blasting System

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

List of
Shipyard Other Machineries

Document Code MO-00

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

The Spec. File Code for this Chapter is MO-00. The list of Shipyard Other Machinery is as follows:

1 Repair Facility Machinery

Sl No.	Name	Total Qty.	Spec. File Code
1.	Side Transfer Winch	02	MO-01N
2.	Marine Sheave Block Pulley	04	MO-01N
3.	Heavy Duty Winch Steel Wire (Hemp Core Type).	1100m (28mm dia)	MO-01N
4.	Rail	1040m	MO-01N
5.	Heavy Lifting Jack	05	MO-01N

2. Dolphin Machinery

Sl No.	Name	Total Qty.	Spec. File Code
1.	Marine Bollard	04	MO-02N
2.	Dolphin Fender	08	MO-02N
3.	Capstan	02	MO-02N

3. Pump and Blasting System Machinery

Sl No.	Name	Total Qty.	Spec. File Code
1.	Fire Pump (Diesel Engine Driven)	01	CW-04
2.	Fire Pump (Electric Motor Driven)	01	CW-04
3.	Jockey Pump (Pressure Maintenance Pump)	01	CW-04
4.	Air Compressor (Screw Type)	02	MO-03N
5.	Hull Washing Pump (High Pressure Jet)	02	MO-03N

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Repair Facility Machinery

Document Code MO-01N

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
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Dhaka 1000, Bangladesh

April 2025

01.TECHNICAL SPECIFICATION OF SIDE TRANSFER WINCH

1. **Name of Equipment**. Side Transfer Winch.

2. **Purpose**. The Side Transfer Winch will be used to transfer ships from the horizontal part of the slipway to the Repair Facility using necessary steel wire ropes, gears, pulleys, drums etc.

3. **Quantity**. As mentioned in the table inside MO-00.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the originality of source and item(s) in order to establish chain of links from the original source to supply:

   a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

   b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

   c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be

clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Up to 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. quantity as mentioned in the table inside MO-00 x Complete set of Side Transfer Winch with accessories, fittings, mountings and others for immediate operation (as per paragraph 13).

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph9, 22&23)

d. Installation to be done by OEM or OEM's representative as per the instruction of the manufacturer, and as per drawing.

12. **Tools**. Required tools are to be supplied with the machine.

13. **Technical Specification**.

a. **General Data**.

The winch has to pull a vessel having **light weight of 2500 Metric** from the horizontal part of the slipway to the rail tracks on Repair Facility, and the winch must have the following features:

1.	Brand	To be mentioned.
2.	Model	To be mentioned.
3.	Pulling capacity	Min 20tonne considering 2 fall pulleys connected to the winch
4.	Electric motor power	Min 10KW (to be mentioned)
5.	Back pulling facility	The winch system should have alternate pulley arrangement at the south end of the Horizontal

		slipway at appropriate location to back pull the vessel from the Repair Facility towards the horizontal portion of the slipway
6.	Gear box	Heavy duty (to be mentioned)
7.	Cradle speed	0.036 meter per second (approx, to be mentioned)
8.	Other features	• Braked motor for appropriate reduction gear • Cast iron motor for marine applications • Speed control option • Protective steel motor cover • Alternative speeds • Alternative supply voltages • Drum guards • Marine coated automatic brake • Adequate length of Steel drum with cable fixing point flange • The drum length should be adequate to accommodate the full set of wire required as per the design of the winch pulling system • Control box with push buttons and emergency stop • Load limiter
9.	Weight	To be mentioned
10.	Dimension	To be mentioned (compact is preferred)

b. **<u>Electrical Requirement</u>**.

1.	Power supply	400 V, 50 Hz, 3 Phase. The machine should have the tolerance of ± 10% voltage fluctuation.
2.	Power of motor	To be mentioned.

Please note that bidders may propose alternative designs within the quoted price, which is subject to the approval of the Tender Evaluation Committee.

c. **Modified Design.** Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **Standard and Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Standard Tools and Special Tools**. Standard tools & special tools and equipment required for erection and commissioning of the machine shall be brought by the supplier. Manufacturer's recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price shall be included in the total price) for the Machine are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.
e) Electrical and Electronic circuit diagram and wiring diagram.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna / NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed between the supplier and the buyer.

02. TECHNICAL SPECIFICATION OF MARINE SHEAVE BLOCK PULLEY

1. **Name of Equipment**. Marine Sheave Block Pulley.

2. **Purpose**. Marine Sheave Block Pulley will be used for all types of rope hauling operations in the Repair Facility.

3. **Quantity**. 4 (Four) in number.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Total 4(Four)x Complete set of Marine Sheave Block Pulley are to be supplied and installed wherever necessary with accessories, fixings, and other items for immediate operation and maintenance (as per paragraph 13)

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22&23)

d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer, and as per drawing.

12. **Tools**. Required tools to be supplied with the machine.

13. **Technical Specification**.

a. **General Features**:

1) The Sheave Block Pulleys will be used for all types of rope hauling operations.
2) Sheaves must be of Caststeel, shackle carbon steel and plate carbon steel
3) High quality marine paint system
4) All equipment are to be manufactured to the international standards

b. **General Data**.

1.	Minimum pull Capacity (for Side transfer Pulley):	20 tonne (approximate)
2.	Speed	3 m/min (maximum).

3.	Diameter of Sheave	To be mentioned
4.	Diameter of Steel Wire Rope	28mm (to be mentioned)

c. **Modified Design**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the item shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the item are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for

evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna / NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

03. TECHNICAL SPECIFICATION OF HEAVY DUTY WINCH STEEL WIRE (HEMP CORE TYPE)

1. **Name of Equipment**. Heavy Duty Winch Steel Wire (Hemp Core Type).

2. **Purpose**. Heavy Duty Winch Steel Wire will be used for the pulling operation of ship during docking, and undocking of ship on the Repair Facility.

3. **Quantity**. 1100(One thousand One Hundred) meter of 28 mm diameter.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. To be mentioned.

7. **Manufacturing Country**. To be mentioned.

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. 1100 (One thousand and One Hundred) meter of 28mm diameter wire with accessories, fittings and others for immediate operation (as per paragraph 13).

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22 & 23).

d. Installation to be done by OEM or OEM's representative as per the instruction of the manufacturer, and as per drawing.

12. **Technical Specification**.

a. General Features.

1. Greater flexibility
2. Less Abrasion
3. Higher breaking strength
4. Longer lifetime
5. Fiber core or Steel Core
6. Wear and Crush resistant

b. **Other Features**.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Marine type
4.	Construction	6X36/41 WS (preferred, to be mentioned)
5.	Lay	Right Hand Regular Lay (RHRL) (preferred, to be mentioned)
6.	Core	Fiber core or Steel core
7.	Grade	EIPS (Extra Improved Plow Steel) (Preferred, to be mentioned)
8.	Breaking Load	28 mm dia steel wire : **Minimum 55Tonne**

c. Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

13. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

14. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc.).
c) Installation instruction and drawings.

15. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive.

16. **Warranty**.
a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram /NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free cost.

17. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

18. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

19. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly the supplier and the buyer.

04. TECHNICAL SPECIFICATION OF REPAIR FACILITY RAIL

1. General Description

The steel rails shall be installed in continuous slots formed on the top surface of the reinforced concrete structure to the details and dimensions shown in the shop drawing of manufacturer. In the tender drawing, the provisions of cradle and other accessories are typical and approximate. However, deviations should not be significant. The exact dimensions and installation guidelines are to be provided by the bidder, when the work is decided to be executed. For the purpose of installing the rails, galvanized high tensile steel holding down bolts shall be cast along the slot and sleeves shall be formed around each bolt to allow for adjustment in the laying of the slip-way rails. Each sleeve shall be protected to avoid ingress of material and each bolt shall be supplied with 2(two) galvanized washers and nuts. Stopper key shall be provided at both extreme edges of the rails as a measure of safety precautions. The rail steel must of marine grade structural steel.

2. Quantity

The length of the Repair Facility rail is 1100 m (approx.)

3. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned)

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

7. References / Standards

The materials properties and installation procedure shall conform to the requirements of
Section "Structural Steel" and also the notes that may appear on the shop drawing.

8. Submittals

Contractor shall submit the following manufacturers' Information for approval prior to installation of rails.

(I) Shop drawings and/or catalogues for rails shall be submitted indicating size,
weight and mounting requirements.
(II) Design calculations demonstrating proposed rail meeting the loading requirements.

(III) Bearings / Base plates.
(IV) Anchor bolts.
(V) Rail clips.
(VI) Bolts, Nuts, & Washers.
(VII) Grouting.

Contractor shall submit the manufacturer's certificate conforming the requirement of relevant Specifications of the items and get approved by the Engineer before the installation of the rails.

9. Materials and Installation

9.1. Preparation of Rail Slot

Prior to setting up the bedding plates and the rails inside surface of the slipway rail slots shall be scrabbled to expose the aggregate. The protective caps over the bolt sleeves shall be removed and the sleeves and slots shall be cleaned by compressed air
and water, or other approved method, to remove all foreign materials. The prepared surface shall be capable of providing an effective bond between the existing concrete and the grout.

9.2. Bearing / Base Plate

Steel for bearing plate shall be of ASTM Grade 420 and shall comply with the relevant
clauses of relevant ASTM specifications or equivalent. No bearing plate shall be installed without testing by any approved laboratory.

Bearing plates shall be delivered to the site in maximum practical length possible but not less
than 8 m. No site joining will be permitted. The gap between adjacent plates shall not be greater than 3 mm and shall be located in the middle of the distances between holding down bolts and in accordance with the Drawing, at expansion joints (if any), the gap between plates shall be 20 mm. The base plate shall be at least 155 mm larger than the base of the rail section and shall have as least 20 mm thickness.

9.3. Rails and Rail Clips

Rail shall be supplied as per the dimensions mentioned in the Drawing. The rail material shall have a chemical composition and strength complying with the requirements of ASTM AI and ASTM A759 or equivalent approved by the Engineer/PIT.

The rails shall be laid in length as long as practicable but not less than Standard 11.9 m
(39 ft) and welded to form a continuous rail. The rail should be fixed to the bedding plates with rail clips. The Contractor shall weld together the lengths of rail to form continuous lengths between expansion Joints. The clips shall be constructed from cast
iron or other approved material and shall be designed to resist tensile forces in the bolts

when the rail is in position. Full details of the type of clip together with design calculations shall be submitted to the Engineer/ PIT for approval.

The welding method shall have to be approved by the Engineer/ PIT and the finished weld
shall be ground smooth to the exact head profile of the jointed rails. Should any weld prove defective either during the welding or later, a section of rail not less than 3 m long
and with one end at least 300 mm clear of the defective weld shall be cut and a new portion of rail shall be welded in its place. In this regard all the cost shall be borne by the Contractor. The tolerances in line, levels and gauge of the rails shall meet the functional
requirements of the proposed slipway.

9.4. Trial Installation

A trial Installation to determine an acceptable rail and base plate placing system and an acceptable grout system shall be carried out by the Contractor prior to commencement of the permanent work. Contractor shall include the cost for this trial installation at his contract rate for laying the track. The Contractor shall place a minimum
length of 3.5 m of base plate and rail, complete with bolts, block outs etc. and shall demonstrate his proposed method of installation of the slipway rails. The trial grouting
shall be carried out under the supervision of grout manufacturer, supplier and witnessed
by the Engineer/ PIT. Contractor shall obtain the manufacturer's written approval for the
procedure, as verified by the trial installation, prior to commencing the permanent work.

The trial installation shall be designed to verify full grout penetration, the absence of air
pockets and the absence of unsound areas No grouting of permanent works shall commence until the Engineer/ PIT gives the written approval for the installation method.

9.5. Measurement

(a) The rail shall be supplied and installed with necessary fittings and fixings of rails and all other components of the rail as per the Drawings and instruction of the Engineer/ PIT. Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Contractor may

incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

9.6. Material properties:

- Tensile strength min 880 mpa
- Elongation min 9%
- Chemical composition:
  C: 0.65-0.76%
  Silicon: 0.15-0.35 %
  Mn: 1.1-1.4 %
  S: max 0.03%
  P: 0.03% (max)
  Cr: 0.25% (max)
  Ni: 0.25% (max)
  Cu: 0.25% (max)

9.7. Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

05. TECHNICAL SPECIFICATION OF HEAVY LIFTING JACK

1. **Name of Equipment**. Heavy Lifting Jack.

2. **Purpose**. Heavy Lifting Jack will be used to uplift different blocks of the Side Transfer Cradle and place wooden blocks beneath it in the Repair Facility.

3. **Quantity**. 5 (Five) in number.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be

clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Total 5(Five)x Complete set of Heavy Lifting Jack are to be supplied and installed wherever necessary with accessories, fixings, and other items for immediate operation and maintenance (as per paragraph 13)

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22&23)

d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer, and as per drawing.

12. **Tools**. Required tools to be supplied with the machine.

13. **Technical Specification**.

a. **General Features**:

1) Hydraulic jack shall be designed for lifting heavy loads..

2) The plunger shall have the function of retracting automatically.

3) hydraulic jack must be suitable to use in marine working environments

b. **General Data**.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Minimum lifting capacity	100tonne
4.	Self-Height	To be mentioned
5.	Stroke	To be mentioned
6.	Outer Diameter	To be mentioned

7.	Inner Diameter	To be mentioned
8.	Weight	To be mentioned
9.	Effective Area	To be mentioned
10.	Hydraulic Pump details	To be mentioned

14. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the item shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the item are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna / NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Dolphin Machinery

Document Code MO-02N

Prepared by

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01. TECHNICAL SPECIFICATION MARINE BOLLARD

1. **Name of Equipment**. Marine Bollard.

2. **Purpose**. Marine bollard will be used for all types of rope hauling operations in the Dolphin.

3. **Quantity**. As mentioned in the table inside MO-00.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacturer**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. To be mentioned.

7. **Manufacturing Country**. To be mentioned.

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standardization (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the item will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Quantity as mentioned in the table inside MO-00x Complete set of marine bollard with accessories, fixings, and other items for immediate operation (as per paragraph 13)
b. Documentation (as per paragraph18).
c. Certification (as per paragraph 9, 22 & 23).
d. Installation to be done by OEM or OEM representative as per the instruction of the manufacturer and as per drawing.

12. **Technical Specification**.

a. **General Features**.

1) High quality SG iron as standard
2) Strong and durable designs
3) Very low maintenance
4) All equipment are manufactured to the international standards.

b. **Electrical Requirement**.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Marine Tee Head Bollard
4.	Bollard Pull Capacity	100KN (minimum)
5.	Material Standard	Cast Steel/Cast Iron (JIS G5501, ASTM A27 65-35, ASTM A48 Class 30.) And (to be mentioned)
6.	Height of bollard	237mm (minimum)
7.	Finish	Bituminous paint (to be mentioned)
8.	Application	Shipyard Mooring System
9.	Bolt Size	M20 (preferred, to be mentioned)
10.	Bolt length	450mm (to be mentioned)
11.	No of Bolts	4 (To be mentioned)

c. **Modified Design**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

13. **Necessary Accessories**. Manufacturer's recommended all standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Item without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the item. A list of standard and necessary accessories should be submitted with the offer.

14. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Item is to be provided. A list with technical details of these items including the following should be given with the offer.

15. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the item:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.

16. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

17. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

18. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

19. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.
b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

20. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly the supplier and the buyer.

02. TECHNICAL SPECIFICATION OF DOLPHIN FENDER

1. **Name of Equipment**. Dolphin Fender.

2. **Purpose**. Dolphin Fender will be used for absorbing the berthing forces of ships on the Dolphins.

3. **Quantity**. As mentioned in the table inside MO-00. Fenders will be installed on the Dolphin.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacturer**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. Bangladesh or to be mentioned.

7. **Manufacturing Country** Bangladesh or to be mentioned.

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standardization (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the item will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Up to 90%

c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Quantity As mentioned in the table inside MO-00x Complete set of Dolphin Fender with accessories, fixings, and other items (as per paragraph 12).
b. Documentation (as per paragraph 17).
c. Certification (as per paragraph 8, 21 & 22)
d. Installation to be done by OEM or OEM's representative as per the instruction of the manufacturer, and as per drawing.

12. **Technical Specification**.

a. **General Features**.

1) **Rubber Fender**
General
For safe docking of the vessels, all front piles and girders of Dolphin shall be protected with a proper fender system. This specification consists of supply, installation and fabrication of a fender system consisting of panel that is of closed box construction, Facia Pads, cone rubber fenders, D-fenders as per the dimensions and arrangement shown in the drawing. The fender specification will be used to design a fender system which will protect ships of the specified sizes (see below) as well as dolphin structure and equipment.
Fenders shall be designed having service life in excess of 15 years. These should be able to absorb the impact of vessels when berthing and avoid damage to ship and structures during lay days. The Engineers approval to the substitution and to the detailed Drawing showing the substitution shall be obtained before fabrication is conducted.

2) **References**
The design complies with the requirements of the Standards and Regulations as listed in Table "List of Standard Tests" unless otherwise required by the specification documents. The principal design documents should include but are not limited to:-

Table: List of Standard Tests

ASTM D 395	Standard Test Methods for Rubber Property – Compression Set
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM D 429	Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
ASTM D 471	Standard Test Methods for Rubber Property –Effect of Liquids

ASTM D 572	Standard Test Methods for Rubber-Deterioration by Heat and Oxygen
ASTM D 573	Standard Test Methods for Rubber-Deterioration in an Air Oven
ASTM D 575	Standard Test Methods for Rubber Properties in Compression
ASTM D 624	Standard Test Methods for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastometers
ASTM D 1171	Standard Test Methods for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 2137	Standard Test Methods for Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics
ASTM D 2240	Standard Test Methods for Rubber Property-Durometer Hardness

Where standards applicable to design, manufacture or finishing of specific components are not clearly stipulated, appropriate AS, BS, EN, ISO, DIN, ASTM, JIS or other internationally recognized standards shall be used. In the absence of appropriate standards, good engineering practice will be adopted in consultation with the Engineer.

3) **Design Vessels Data**

Vessel Type	**Light weight displacement (Tonne)**	**L_{OA} (m)**	**Draft (m)**	**Beam (m)**	**Free board (m)**
Navy Vessel	3000 (Max)	120	4.0m (approx.)	13 (approx.)	5.00 (approx)

Tides & Levels
Fenders shall consider the following tides & levels:
MHWS : + 4.791 m CD
MSL(ML is considered as MSL where ML=Mean level) : + 2.619m CD
MLWS :+0.447m CD
(Source: Navy Data)

Deck Level Top: + 6.0 m CD

Fender System Design Parameters
The fender shall be designed to the following parameters as per the specification unless noted adjacent.

a. Minimum energy absorption 480 kN-m
b. Berthing approach angle: 10 Degree (Quarter point berthing)
c. Fender to fender spacing: 6 m

Fender System Selection

The chosen fender arrangement should meet the specification and the above requirement. The panel is of closed box construction spanning of 2000 mm Width x 4500 mm Length with 290mm Thickness (minimum to be mentioned) UHMW-PE Facia Pads (Black Color).

The panel of the fender will be connected to steel piles with necessary fittings and mountings. Behind the steel pile a cone fender of 1680mm (approx.) diameter will be connected. The connection between the steel piles and the cone fender will be done by a steel plate of 20mm thickness (minimum) and 2000mm Width x 2000mm Length (approx.). There should be enough space on the Dolphin Jetty face to install the base of the cone fender.

At the North West Corner and South West Corner of the Dolphin one Arch Fender at each dolphin coupled with D type fender will be used to protect the corners from the impacts of vessels. The Arch fender shall have minimum 1850mm width at the base, 650mm width at the top face, 1800 mm length and 1000mm high while having the minimum energy absorption capacity as stated above. The fender will be fitted with anchor bolts on the dolphin faces. A D-type fender having base width of 400mm and height of 400mm will be fitted on the arch fender through a H steel pile having dimensions as shown in the dolphin drawings. The D type fender shall be extended from the top of the dolphin to a certain length as shown in the drawings of dolphin.

Alternatively, the bidder may propose alternative fender system.

Performance

The proposed fender system shall be capable of absorbing of a maximum reaction at the following deflection. The tolerance for performance shall be +/- 10% of the published performance for the fender unit(s).

Design Deflection:

Minimum energy	= 480 KN-m
Maximum allowable reaction	= 800 KN

Materials

Fenders shall be manufactured using natural rubber that is compounded to provide resistance to ageing, seawater fatigue and abrasion. The material shall be uniform in quality and free from any foreign substances, cracks and defects that could be detrimental to the performance of the unit. The fender shall be manufactured with steel plates completely embedded in the fender and bonded to the rubber by vulcanizing the fender at elevated temperatures and pressures.
The material must be homogeneous in quality and free from foreign materials, bubbles, injuries, cracks and other harmful defects.

The embedded fixing steel plates shall be firmly bonded into the rubber body through the process of vulcanization, and completely encapsulated so that no steel is exposed. The steel plate should be thick enough to eliminate the danger to break or crack.
Rubber fender shall conform to the dimensions and shapes as mentioned in the Drawing and the relevant specifications for properties mentioned in the Table.

Rubber Properties and Acceptance Requirements

The fender material conforms to the requirements as shown in table below.

Tensile Strength	DIN 53504; ASTM D-412 Die C; AS 1180.2 BS ISO 37; JIS K 6251	Original	16.0 MPa (minimum)
		Aged for 96 hours at 70°C	12.8 MPa (minimum)
Elongation at Break	DIN 53504; ASTM D-412 Die C; AS 1180.2 BS ISO 37; JIS K 6251	Original	350%
		Aged for 96 hours at 70°C	280%
Hardness	DIN 53505; ASTM D-2240; AS 1683.15.2; JIS K 6253	Original	78º Shore A (maximum)
		Aged for 96 hours at 70°C	Original + 8º Shore A (maximum)
Compression Set	ASTM D-395 Method B; AS 1683.13 Method B; BS 903 A6; ISO 815; JIS K 6262	22 hours at 70ºC	30% (maximum)
Tear Resistance	ASTM D-624 Die B; AS 1683.12; BS ISO 34-1; JIS K 6252	Original	70 kN/m (minimum)
Ozone Resistance	DIN 53509; ASTM D-1149; AS 1683-24; BS ISO 1431-1; JIS K 6259	50pphm at 20% stain, 40ºC, 100 hours	No Cracks
Seawater Resistance	BS ISO 1817; ASTM D 471	28 days at 95°C	Hardness: ±10°Shore A (max) Volume: +10/-5% (max)
Abrasion	ASTM D5963-04; BS ISO	Original	1000 mm^3 (max)

	4649: 2002		
	BS903 A9, Method B	3000 revolutions	1.5cc (max)
Bond Strength	ASTM D429, Method B; BS 903.A21 Section 21.1	Rubber to steel	7N/mm (min)
Dynamics Fatigue	ASTM D430-95, Method B	15,000 cycles	Grade 0-1

Hardware
All hardware for mounting of the fender to the panel shall be supplied by the Contractor. All hardware for mounting the fender to the concrete face including anchor, bolts, hex bolts, nuts and washers shall be included. All mounting hardware shall be hot dipped galvanized, stainless steel or equivalent. The size and grades of the mounting hardware shall be according to the fender manufacturer's recommendations.

Construction Materials of Frontal Panel
Steel Panels & Panel Construction

The steel for the frontal panels shall conform to IS2062 for the main section members, stiffeners and any chain lugs. The panel shall conform to PIANC recommended steel thickness.

Plates Exposed on 2 surfaces: 12mm
Plates Exposed on 1 surface: 9-10mm
Internal Members (not exposed): 8mm

This construction dimensions are for the proposed system. However, in case of alternative design the bidder must mention appropriate hardware dimensions accordingly.

Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

13. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Item without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the item. A list of standard and necessary accessories should be submitted with the offer.

14. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the item shall be brought by the supplier.

Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the item should be supplied. List of standard and special tools will be submitted with the offer.

15. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Item is to be provided. A list with technical details of these items should be given with the offer.

16. **Spare Parts**. A list of recommended fast moving spare parts with item wise price (price not included in the total price) for the Item are to be provided with the quotation.

17. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the item:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.

18. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

19. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna / NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

20. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

21. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

22. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.
b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

23. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

03. TECHNICAL SPECIFICATION OF MARINE CAPSTAN

1. **Name of Equipment**. Marine capstan.

2. **Purpose**. Marine Capstan will be used for the rope hauling operations in the slipway to pull and align the ship on cradle while docking the ships.

3. **Quantity**. 02 (Two) in number. These will be placed as per drawing.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacturer**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. 02(Two) x Complete set of Marine capstan with accessories, fixings, and other items for immediate operation (as per paragraph 12).
b. Documentation (as per paragraph 18).
c. Certification (as per paragraph 9, 22& 23)
d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer and as per drawing location.

12. **Tools**. Required tools to be supplied with the machine.

13. **Technical Specification**.

a. **General Features**.

1) The capstan will be used for all types of rope hauling operations.
2) The connection of the power lines and control circuitry to the capstan must be done by skilled technicians, to ensure reliable and safe operation of the capstan.
3) The capstan should operate in both clockwise and anticlockwise direction, depending on how the connections to the motor are made.
4) Cast or fabricated heads.
5) Foot mounted.
6) Direct or gearbox driven.
7) High quality marine paint system.
8) All equipment are manufactured to the International standards.

b. **Other Features**.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Electric AC Drive Vertical motor
4.	Minimum pull capacity	150 KN (approximate)
5.	Minimum Continuous pull capacity	150 KN (approximate, to be mentioned)

6.	Speed (@50Hz)	10-12 m/min (Approximate, to be mentioned)
7.	Current at continuous pull rating (@400V / 50Hz)	To be mentioned
8.	Current at start up DOL (@400V)	To be mentioned
9.	Minimum Motor Power	20 ~ 25 kW (to be mentioned)
10.	Operating Voltage Range	400 – 440 V/AC/50Hz/3 Phase. The machine should have the tolerance of ± 10% voltage fluctuation.
11.	Control	Local to be mentioned
12.	Diameter of Drum	To be mentioned
13.	Diameter of Wire Rope	20 ~ 40 mm (to be mentioned)
14.	Material	Stainless Steel drum & light weight (to be mentioned)
15.	IP Number	IP 66/44 and to be mentioned

c. **Modified Design**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied

with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the machine shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the Machine are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.
e) Electrical and Electronic circuit diagram and wiring diagram.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.
b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly the supplier and the buyer.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Pump and Blasting System

Document Code MO-03N

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

01. TECHNICAL SPECIFICATION OF AIR COMPRESSOR

1. **Name of Equipment**. Air Compressor.

2. **Purpose**. Air compressor (Screw type) unit will be used to supply dry and clean compressed air for blasting works.

3. **Quantity**. As mentioned in the table inside MO-00.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacturer**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Ambient Conditions.**

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

10. **Scope of Supply**. 01 X air compressor (Screw type) will be supplied as per specifications with all standard accessories, fittings, attachments etc. and complete in all respect for immediate operation as per paragraph 11 to 24.

11. **Technical specification**, Main technical requirements of the Screw Type Air Compressor are in given below:

Sl	Description	Specification
a)	Type	Screw type LP air compressor
b)	Model	To be mentioned
c)	Maker	To be mentioned
d)	Capacity	8-9 m^3/min
e)	Rated Operating pressure	8-10 bar
f)	Compressor discharge Pressure	To be mentioned
g)	High Pressure Air Hose with trigger gun	Flexible 2x 200 m hose reeled on wheel drum along with trigger gun (To be mentioned)
h)	Electrical Motor	
	Power	To be mentioned

	Voltage	380-415 V
	Phase	3-Phase
	Frequency	50Hz
	Current	To be mentioned
	Speed	To be mentioned
	Cooling System	Air Cooled
i)	Starting Amp	To be mentioned
j)	Tripped point	To be mentioned

12. **Fittings/Attachments**. All necessary fittings/attachments including the followings will be provided with Air compressor.

Sl	Description
a)	Efficient Separation System Oil separator
b)	Noise enclosure, Less then 65 dBA (To be mentioned)
c)	Protection devices for motor and compressor
d)	Stainless Steel Oil Pipe and Air Pipe enclosure
e)	Automatic regulation
f)	Automatic stop start control
g)	Discharge air pressure gauge
h)	Inlet air pressure gauge
i)	Hour meter
j)	Starter arrangement
k)	Cooler
l)	Safety devices /protection (i) High air temperature (ii) High oil temperature (iii) Dual motor protection via thermal overload relay and motor winding thermistor (iv) Safety valve on separator
m)	Variable Speed Drive system
n)	Stainless steel screw

13. **Standard Accessories.** Standard accessories including essential item and accessories those are needed to operate the Compressor mentioned followings:

a) Discharge temperature gauge.
b) Power on light.
c) Line/Sump selector or ava
d) Start-stop push buttons.
e) Normal-Unload selector.
f) Coolant filter maintenance indicator light.
g) Air filter maintenance indicator light
h) Control fuses
i) Timer
j) Control relay
k) Fan motor overload relay

l) Power inlet terminals.
m) Vacuum switch.
n) Thermistor Control Unit.
o) Intelligent Control and Protection devices.

14. Spare parts. Following spare parts to be supplied for compressor.

Sl	Description	Unit	Qty	Remarks
a)	Oil filter	Nos	05	
b)	Air filter	Nos	05	
c)	Separator element	Nos	05	
d)	Drain filter element	Nos	03	
e)	Flex coupling	Nos	03	
f)	Fan motor bearing	Nos	02	
g)	Timer	Nos	02	
h)	Overload relay	Nos	02	
i)	Start-stop push buttons	Nos	03	
j)	Discharge temperature switch	Nos	02	
k)	Transducer pressure	Nos	02	

15. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Item without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the item. A list of standard and necessary accessories should be submitted with the offer.

16. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the item shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the item should be supplied. List of standard and special tools will be submitted with the offer.

17. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Item is to be provided. A list with technical details of these items should be given with the offer.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the item:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction,

clearance, tolerance, material specifications, etc).

c) Installation instruction and drawings.

d) Parts catalogue with internationally recognized part no.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD, Khulna/NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

02. TECHNICAL SPECIFICATION OF HULL WASHING PUMP

1. **Name of the Equipment**. Hull Washing Pump (Capacity: 650 Bar).

2. **Purpose**. The pump will be used for cleaning debris and salt water from ships hull after docking.

3. **Quantity**. 02 (Two) in number complete set.

4. **Manufacturer, Principal Supplier & Local Supplier**. Name and full address to be mentioned.

1.	Manufacturer	To be mentioned.
2.	Principle Supplier	To be mentioned.
3.	Local Supplier	To be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, EU Countries, Canada, Japan, South Korea, Turkiye (Turkey), Australia and New Zealand (To be mentioned).

7. **Country of Manufacture**. USA, UK, EU Countries, Canada, Japan, South Korea, Turkiye (Turkey), Australia, New Zealand and China (To be mentioned)

8. **Certificate/ Document of Authentication.** The local supplier must provide following certificate(s)/ document(s) with the offer/quotation of items as regard to the genuineness of source and item(s) in order to establish chain of links from the original source to supply:

a. One certificate/ document by the manufacturer in favor of the supplier (in case of manufacturer as direct source).

b. Two certificates/ documents, one by the manufacturer to authorized agent and other by the authorized agent to supplier (in case of authorized agent as immediate source).

c. Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard.** The Machine is to be designed and constructed fulfilling the requirement of international standard (ISO, CE, DIN etc).

10. **Operating Environment of Equipment.**

1.	Temperature	$+05^0$C to $+50^0$C
2.	Relative Humidity	Up to 90%
3.	Location	Close to the sea shore

11. **Scope of Supply.** The scope of supply is to include the followings:

a. Main items (02 x Hull Washing Pump) complete with all items necessary for immediate operation without the requirement of any other items (standard fittings/attachments, accessories, etc as per paragraph 12 to 13).
b. Optional items (as per paragraph 14).
c. Tools (as per paragraph 15)
d. Spare parts (as per paragraph 16).
e. Documents (as per paragraph 17).
f. Test, Trial and Acceptance (as per paragraph 18).
g. Warranty (as per paragraph 19).
h. Any other issue relevant (if any).

12. **Technical Specification**.

1.	Type	High pressure water jet cleaning machine (Fixed type)
2.	Model	To be mentioned.
3.	Maker	To be mentioned.
4.	Power	Electric Driven
5.	Operating Pressure Range	Minimum 650 bar
6.	Flow Rate	Minimum 80 Ltr/Minute
7.	Motor Power (kW)	To be mentioned
8.	Power Supply	415V, 50 Hz, Three Phases. The motor should have the tolerance of ± 10% voltage fluctuation.
9.	Spray Gun	Easy press trigger gun
10.	Nozzle	Full set as per standard
11.	Safety Device	To be mentioned
12.	High Pressure Hose	Flexible 200 m hose reeled on wheel drum inside pump house for each pump set(To be mentioned)
13.	Insulation	F class
14.	Power Cable	Standard (to be mentioned)

13. **Standard Accessories.** Standard accessories which are essential to operate the machine, whether those are mentioned in this specification or not, are to

be provided. A list of such items / accessories indicating item wise price must be included in the quotation. The **prices will be added** to the total price while evaluating the comparative price of the bidders.

14. **Optional Items**. A list of optional items which may be required for each Water Jet Cleaning Machines are to be provided indicating item wise price. The **prices will not be added** to the total price while evaluating the comparative price of the bidders.

15. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the Machine are to be provided with the quotation.

16. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a. Operation and maintenance manual.
b. Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c. Installation instruction and drawings.
d. Parts catalogue with internationally recognized part no.
e. Electrical and Electronic circuit diagram and wiring diagram.

17. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

18. Warranty.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram /NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect at no cost to the purchaser.

19. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

20. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

21. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.
b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

22. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointlyby the supplier and the buyer.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

List of
Slipway Machinery
Document Code MS-00

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

General Description

Bangladesh Navy (BN) intends to establish a Ship Docking and Repair Facility to carry out docking, undocking, repair and maintenance of naval ships and crafts. Proposed Ship Docking and Repair Facility will be capable of docking and undocking at least two ships of 120-meter length and 2500-ton Light Weight throughout the year. BN ships will be lifted for repair and maintenance from the river to the proposed land area of BNS MONGLA by the side docking and undocking method using cradle, winch, wire and pulley. Then the docked ships will be transferred to the Repair Facility (designated area to place the docked ships) for repair and maintenance works by Side transfer method.

The length of the slipway is 148m x 131m. The slipway will have two different inclinations. First 104m from the river end shall have 1: 9.25 (6.17 degree) linear slope. The remaining 44m shall be in horizontal position. Vessel shall be docked and undocked through the slipway in even keel condition. The cradle system that will be used for docking and undocking operation shall have 3 parts. Initially the 3 parts will be lowered altogether into the river to dock the vessel. After placing the vessel on the cradle system, the vessel will be pulled through the inclined slipway. At the end of the inclined slipway bottom part of the cradle will stay on inclined rails and will be held in position using adequate stoppers. Subsequently, the middle part (Intermediate cradle) will carry the ship along with the top cradle (Side Transfer Cradle)from the inclined rails to the horizontal rails (Transfer Area).Ultimately the top cradle (Side Transfer Cradle) will transfer the ship from the Transfer Area to the Repair Facility.

The Slipway will consist of 26 rails throughout the length to evenly distribute load of the vessel and the cradle on the slipway structure. Moreover, there will be another 2 pairs of rails on Repair Facility to facilitate the side transfer operation. During docking and undocking operation, the ships will be supported by a suitable number of capstans and bollards along the length of the slipway. Capstans will also be placed the dolphins to adjust the alignment of the ships on the cradle while afloat.

Slipway Machinery and Cradle System

Spec. File Code for this chapter is MS-00. The list of Slipway machinery is as follows:

Sl No.	Name	Qty.	Spec. File Code
1	Slipway Winch	Complete System	MS-01
2	Marine Sheave Block Pulley	12	MS-01
3	Marine Capstan	02	MS-01

Sl No.	Name	Qty.	Spec. File Code
4	Marine Bollard	08	MS-01
5	Heavy Duty Winch Steel Wire (Hemp Core Type)	7200m (32mm dia)	MS-01
6	Slipway Rail	3172 m	MS-01
7	Slipway Cradle	Complete System	MS-01
8	Emergency generator (3-phase, 2x300kVA, 400 V, with sound attenuated canopy and built in 1000Ampere ATS)	2	CW-04

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Slipway Machinery

Document Code MS-01

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

01.TECHNICAL SPECIFICATION OF SLIPWAY WINCH

1. **Name of Equipment**. Slipway Winch.

2. **Purpose**. Slipway Winch will be used to dock and undock ships in the proposed slipway using necessary steel wire ropes, gears, pulleys, drums etc.

3. **Quantity**. Complete winch system with all accessories to dock and undock of ships. Details to be found in para 13(a).

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standardization (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to

be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Complete set of Slipway Winch with accessories, fixings, and other items for immediate operation (as per paragraph 13).
b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22& 23)

d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer and as per drawing.

12. **Tools**. Required tools are to be supplied with the machine.

13. **Technical Specification**.

a) **General Data**.

Technical description of the in-house winch systems having six similar sheaves and blocks for the slipway including delivery of the necessary gear boxes, drums and steel wires. The winch has to pull a vessel having **light weight of 2500 Metric Tonne in a 6.17-degree** (**1: 9.25) linear sloped** slipway and the winch must have the following features:

1.	Brand	To be mentioned.
2.	Model	To be mentioned.
3.	Pulling capacity	• Minimum 16 tonne pulling capacity is required considering 6(six) individual synchronous winches operated through a control panel with 6 fall pulley connected to each

		of the winch. • Alternatively, minimum 96 tonne pulling capacity is required considering a single (01) winch that will be connected to 6 individual sheave blocks and pulley sets using mechanical shafting mechanism.
4.	Electric motor power	• Minimum 10KW considering 6 individual synchronous winches • Alternatively, Minimum 60KW considering a single winch connected to 6 sheave blocks and pulley sets using mechanical shafting.
5.	Back pulling facility	• The winch system must have back pulling facility for the vessel undocking operation. Bidder has to propose the system in detail.
6.	Gear box	Heavy duty (to be mentioned)
7.	Cradle speed	0.03 meter per second (maximum)
8.	Other features	• Braked motor for appropriate reduction gear • Cast iron motor for marine applications • Speed control option • Protective steel motor cover • Alternative speeds • Alternative supply voltages • Drum guards • Marine coated automatic brake • Adequate length of Steel drum with cable fixing point flange • Control box with push buttons and emergency stop

		• Load limiter • The drum length should be adequate to accommodate the full set of wire required as per the design of the winch pulling system
9.	Weight	To be mentioned
10.	Dimension	To be mentioned (compact is preferred)

b) <u>Electrical Requirement</u>.

1.	Power supply	400 V, 50 Hz, 3 Phase. The machine should have the tolerance of ± 10% voltage fluctuation.
2.	Power of motor	To be mentioned.

c) **<u>Special Notes</u>**: The total pulling capacity required for the winch is approx. 576 tonnes without mechanical advantage added (including safety factor). In the above table of 13 (a) for the mechanical advantage, it has been considered 6 fall pulley system in front of each of the 6 sheave blocks (Mechanical advantage is 6 for each sheave block). The minimum pulling pulley is 96 tonnes (minimum) (for a single winch) or 16 tonnes (minimum) (for each 6 individual synchronous winches). The bidder shall prepare their design considering appropriate mechanical advantage and pulling capacity.

d) **<u>Modified Design</u>**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **<u>Necessary Accessories</u>**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **<u>Special Tools</u>**. Standard and special tools and equipment required for erection and commissioning of the machine shall be brought by the supplier. Manufacturer's recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **<u>Optional Items</u>**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the Machine are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.
e) Electrical and Electronic circuit diagram and wiring diagram.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD Khulna/NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or replacement within 90 (ninety) days from the date of defect atfree of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial

and commissioning an acceptance certificate will be signed jointlyby the supplier and the buyer.

02. TECHNICAL SPECIFICATION OF MARINE SHEAVE BLOCK PULLEY

1. **Name of Equipment**. Marine Sheave Block Pulley.

2. **Purpose**. Marine Sheave Block Pulley will be used for all types of rope hauling operations in the Slipway and Repair Facility.

3. **Quantity**. 12 (Twelve) in number for Slipway sheave blocks and cradle.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China(To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be

clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. Total 12(Twelve)x Complete set of Marine Sheave Block Pulley for slipway sheave blocks, are to be supplied and installed wherever necessary with accessories, fixings, and other items for immediate operation and maintenance (as per paragraph 13)

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22 &23)

d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer and as per drawing.

12. **Tools**. Required tools to be supplied with the machine.

13. **Technical Specification**.

a. General Features:

1) The Sheave Block Pulleys will be used for all types of rope hauling operations.
2) Sheaves must be of Casting steel, shackle carbon steel and plate carbon steel
3) High quality marine paint system
4) All equipment are to be manufactured to the international standards

b. General Data.

1.	Minimum pull capacity (for Slipway Sheave Block Pulley):	100tonne (approximate)
2.	Speed	3 m/min (maximum).
3.	Diameter of Sheave	To be mentioned by Bidder
4.	Diameter of Steel Wire Rope	32 mm and to be mentioned

c. **Modified Design**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the item shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the item are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted calibrator with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of

acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointlyby the supplier and the buyer.

03. TECHNICAL SPECIFICATION OF MARINE CAPSTAN

1. **Name of Equipment**. Marine capstan.

2. **Purpose**. Marine Capstan will be used for the rope hauling operations in the slipway to pull and align the ship on cradle while docking the ships.

3. **Quantity**. 02 (Two) in number. These will be placed as per drawing.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey (To be mentioned).

7. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be

clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. 02(Two)x Complete set of Marine capstan with accessories, fixings, and other items for immediate operation (as per paragraph 13).

b. Documentation (as per paragraph18).

c. Certification (as per paragraph 9, 22 & 23)

d. Installation to be done by OEM or OEM's representatives as per the instruction of the manufacturer and as per drawing.

12. **Tools**.Required tools to be supplied with the machine.

13. **Technical Specification**.

General Features.

1) The capstan will be used for all types of rope hauling operations.
2) The connection of the power lines and control circuitry to the capstan must be done by skilled technicians, to ensure reliable and safe operation of the capstan.
3) The capstan should operate in both clockwise and anticlockwise direction, depending on how the connections to the motors are made.
4) Cast or fabricated heads.
5) Foot mounted.
6) Direct or gearbox driven.
7) High quality marine paint system.
8) All equipment are to be manufactured to the international standards

Other Features.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Electric AC Drive Vertical motor
4.	Minimum pull capacity	150 KN (approximate)
5.	Minimum Continuous pull capacity	150 KN (approximate, to be mentioned)
6.	Speed (@50Hz)	10-12 m/min (Approximate, to be mentioned)
7.	Current at continuous pull rating (@400V / 50Hz)	To be mentioned
8.	Current at start up DOL (@400V)	To be mentioned
9.	Minimum Motor Power	20 ~ 25 kW (to be mentioned)
10.	Operating Voltage Range	400 – 440 V/AC/50Hz/3 Phase. The machine should have the tolerance of ± 10% voltage fluctuation.
11.	Control	Local to be mentioned
12.	Diameter of Drum	To be mentioned
13.	Diameter of Wire Rope	20 ~ 40 mm (to be mentioned)
14.	Material	Stainless Steel drum & light weight (to be mentioned)
15.	IP Number	IP 66/44 and to be mentioned

Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal

must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

14. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

15. **Special Tools**. Standard and special tools and equipment required for erection and commissioning of the machine shall be brought by the supplier. Manufacturer recommended standard and necessary tools (price included in the total price) for operation and maintenance of the machine should be supplied. List of standard and special tools will be submitted with the offer.

16. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

17. **Spare Parts**. A list of recommended spare parts with item wise price (price will be included in the total price) for the Machine are to be provided with the quotation.

18. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.
d) Parts catalogue with internationally recognized part no.
e) Electrical and Electronic circuit diagram and wiring diagram.

19. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive

20. **Warranty**.
a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of

acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days from the date of defect at free of cost.

21. **Guarantee**. The supplier is to give guarantee to supply the spare parts for at least 05 years at reasonable price.

22. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

23. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

24. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

04. TECHNICAL SPECIFICATION OF MARINE BOLLARD

1. **Name of Equipment**. Marine Bollard.

2. **Purpose**. Marine Bollard will be used for all types of rope hauling operations in the slipway while docking and undocking of ships.

3. **Quantity**. 08 (Eight) in number.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. To be mentioned.

7. **Manufacturing Country**. To be mentioned.

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. 08(Eight) x Complete set of Marine Bollard with accessories, fittings and others for immediate operation (as per paragraph 13).

b. Documentation (as per paragraph18).

c. Certification (as per paragraph 9, 22 & 23)

d. Installation to be done by OEM or OEM's representative as per the instruction of the manufacturer and as per drawing.

12. **Technical Specification**.

General Features.

1 High quality SG iron as standard.

2 Strong and durable designs.

3 Very low maintenance,

4 All equipment are to be manufactured to the international standards.

Other Features.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Marine Tee Head Bollard
4.	Bollard Pull Capacity	100KN (minimum)
5.	Material Standard	Cast Steel/Cast Iron (JIS G5501, ASTM A27 65-35, ASTM A48 Class 30.) And (to be mentioned)
6.	Height of bollard	237mm (minimum)
7.	Finish	Bituminous paint (to be mentioned)

8.	Application	Shipyard Mooring System
9.	Bolt Size	M20 (preferred, to be mentioned)
10.	Bolt length	450mm (to be mentioned)
11.	No of Bolts	4 (To be mentioned)

Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

13. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) are to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

14. **Optional Items**. A list of optional items (if any) indicating item wise price (price not included in the total price) which may be required for the advanced operation of the Machine is to be provided. A list with technical details of these items should be given with the offer.

15. **Spare Parts**. A list of recommended fast moving spare parts with item wise price (price will be included in the total price) for the item are to be provided with the quotation.

16. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc.).
c) Installation instruction and drawings.

17. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive.

18. **Warranty**.

a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.

b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram / NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days from the date of defect at free of cost.

19. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

20. **Certificate**. The supplier will provide following certificates:

a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

21. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointlyby the supplier and the buyer.

05. TECHNICAL SPECIFICATION OF HEAVY DUTY WINCH STEEL WIRE (HEMP CORE TYPE)

1. **Name of Equipment**. Heavy Duty Winch Steel Wire (Hemp Core Type).

2. **Purpose**. Heavy Duty Winch Steel Wire will be used for the pulling and Mooring operation of ship during docking, and undocking of ship on the slipway.

3. **Quantity**. 7200 (Seven thousand Two Hundred) meter of 32mm diameter.

4. **Manufacturer**. Name and full address to be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Country of Origin**. To be mentioned.

7. **Manufacturing Country**. To be mentioned.

8. **Certificate/Document of Authentication**. The bidder must provide following certificate(s)/document(s) with the offer/quotation of items as regard to the genuinity of source and item(s) in order to establish chain of links from the original source to supply:

a) One certificate/document by the manufacturer in favour of the bidder (in case of manufacturer as direct source).

b) Two certificates/documents, one by the manufacturer to authorized agent and other by the authorized agent to bidder (in case of authorized agent as immediate source).

c) Three certificate/documents, first one by the manufacturer to authorized agent, second one by authorized agent to sub-agent and third one by sub-agent to bidder (in case sub-agent as immediate source). If the bidder is unable to obtain the first certificate (by manufacturer to authorized agent), then it has to produce relevant document to prove agency-ship of its claimed agent of the recognized manufacturer.

9. **Standard**. The Item/ equipment is to be designed and constructed fulfilling the requirement of internationally recognized standard (ISO, CE, DIN or equivalent). The standards to which the quoted item complies with are to be

clearly specified. The standard approval certificate shall be provided with the offer.

10. **Ambient Condition**. The ambient conditions at which the machine will be used are as follows:

a.	Temperature	05^0C-50^0C
b.	Relative Humidity	Upto 90%
c.	Location	Close to the sea shore

11. **Scope of Supply**. The scope of supply is to include the followings:

a. 7200 (Seven thousand Two Hundred) meter of 32mm diameter Heavy Duty Winch Steel Wire (hemp core type) with accessories, fittings and others for immediate operation (as per paragraph 13).

b. Documentation (as per paragraph 18).

c. Certification (as per paragraph 9, 22& 23)

d. Installation to be done by OEM or OEM's representative as per the instruction of the manufacturer and as per drawing location

12. **Technical Specification**.

General Features.

1. Greater flexibility.
2. Less Abrasion.
3. Higher breaking strength.
4. Longer lifetime.
5. Fiber core or Steel Core.
6. Wear and Crush resistant.

Other Features.

1.	Brand	To be mentioned
2.	Model	To be mentioned
3.	Type	Marine type
4.	Construction	6X36/41 WS (preferred, to be mentioned)
5.	Lay	Right Hand Regular Lay (RHRL) (preferred, to be mentioned)
6.	Core	Fiber core or Steel core
7.	Grade	EIPS (Extra Improved Plow Steel) (Preferred, to be mentioned)
8.	Breaking Load	32 mm dia steel wire :Minimum 70 Tonne

Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

13. **Necessary Accessories**. Manufacturer's recommended standard and necessary accessories and attachments (price included in the total price) for smooth and immediate operation of the Machine without the requirement of any other items (attachments, accessories, consumables, etc.) to be supplied with the machine. A list of standard and necessary accessories should be submitted with the offer.

14. **Documents**. Two (02) sets of following documents (in English language) are to be provided free of cost along with the machine:

a) Operation and maintenance manual.
b) Workshop level repair manual (including various repair instruction, clearance, tolerance, material specifications, etc).
c) Installation instruction and drawings.

15. **Supporting Documents Including Product Brochure/ Catalogue**. 01 (one) set of original brochure/ booklet, operation and maintenance manual, products catalogue in English including detail technical information about the quoted item with accessories are to be provided along with the quotation for evaluation/ assessment. Non-submission of such supporting documents will render the offer technically non-responsive.

16. **Warranty**.
a. Minimum 12 (Twelve) Month's warranty for trouble free operation is to be provided by the supplier/ manufacturer for the item from the date of acceptance by the buyer. If any component of the supplied items becomes defective during the warranty period, the warranty shall be extended automatically (for relevant component) for the period of the subject component remains defective.
b. For warranty repair/ replacement, the supplier will collect the defective item from NSD, Chattogram /NSD Khulna/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days the date of defect at free of cost.
17. **Quality Assurance Certificate**. Quality Assurance Certificate in respect of the associated equipment in regards to its manufacturing and performance is to be provided at the time of delivery of the items.

18. **Certificate**. The supplier will provide following certificates:
a. Manufacturer's Authorization Certificate with the offer.

b. Pre-delivery Inspection Certificate (in English) prior to delivery are to be provided by the supplier.

19. **Test, trial and Acceptance**. Test and Trial will be carried out jointly at buyer site in presence of supplier's representative. After satisfactory test, trial and commissioning an acceptance certificate will be signed jointly by the supplier and the buyer.

06. TECHNICAL SPECIFICATION OF SLIPWAY RAIL

1. General Description

The steel rails shall be installed in continuous slots formed on the top surface of the reinforced concrete structure to the details and dimensions shown in the shop drawing of manufacturer. In the tender drawing, the provisions of cradle andother accessories are typical and approximate. However, deviations should not be significant. The exact dimensions and installation guidelines areto be provided by the bidder, when the work is decided to be executed. For the purpose of installing the rails, galvanized high tensile steel holding down bolts shall be cast along the slot and sleeves shall be formed around each bolt to allow for adjustment in the laying of the slip-way rails. Each sleeve shall be protected to avoid ingress of material and each bolt shall be supplied with 2(two) galvanized washers and nuts. Stopper key shall be provided at both extreme edges of the rails as a measure of safety precautions. The rail steel must of marine grade structural steel.

2. Quantity

The length of the slipway rail is 3900m (approx.). The item should be brand new.

3. **Country of Origin**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea and Turkey (To be mentioned).

4. **Manufacturer**. To be mentioned.

5. **Year of Manufacture**. 2024 or later. The item should be brand new and original.

6. **Manufacturing Country**. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned).

7. References / Standards

The materials properties and installation procedure shall conform to the requirements of Section "Structural Steel" and also the notes that may appear on the shop drawing.

8. Submittals

Contractor shall submit the following manufacturers' Information for approval prior to installation of rails.

(I) Shop drawings and/or catalogues for rails shall be submitted indicating size, weight and mounting requirements.
(II) Design calculations demonstrating proposed rail meeting the loading requirements.
(III) Bearings/ Base plates.
(IV) Anchor bolts.
(V) Rail clips.
(VI) Bolts, Nuts, & Washers.
(VII) Grouting.

Contractor shall submit the manufacturer's certificate conforming the requirement of relevant Specifications of the items and get approved by the Engineer before the installation of the rails.

9. Materials and Installation

9.1. Preparation of Rail Slot

Prior to setting up the bedding plates and the rails the surface of the slipway rail slots shall be scrabbled to expose the aggregate. The protective caps over the bolt sleeves shall be removed and the sleeves and slots shall be cleaned by compressed air and water, or other approved method, to remove all foreign materials. The prepared surface shall be capable of providing an effective bond between the existing concrete and the grout.

9.2. Bearing / Base Plate

Steel for bearing plate shall be of ASTM Grade 420 and shall comply with the relevant clauses of relevant ASTM specifications or equivalent. No bearing plate shall be installed without testing by any approved laboratory. Bearing plates shall be delivered to the site in maximum practical length possible but not less than 8 m. No site joining will be permitted. The gap between adjacent plates shall not be greater than 3 mm and shall be located in the middle of the distances between holding down bolts and in accordance with the Drawing, at expansion joints (if any), the gap between plates shall be 20 mm. The base plate shall be at least 155mm larger than the base of the rail section and shall have as least 20mm thickness.

9.3. Slipway Rails and Rail Clips

Slipway rail shall be supplied as per the dimensions mentioned in the Drawing. The rail material shall have a chemical composition and strength complying with the requirements of ASTM AI and ASTM A759 or equivalent approved by the Engineer/PIT.

The rails shall be laid in length as long as practicable but not less than Standard 11.9 m (39 ft) and welded to form a continuous rail. The rail should be fixed to the bedding plates with rail clips. The Contractor shall weld together the lengths of rail to form continuous lengths between expansion Joints. The clips shall be constructed from cast iron or other approved material and shall be designed to resist tensile forces in the bolts when the rail is in position. Full details of the type of clip together with design calculations shall be submitted to the Engineer/ PIT for approval.

The welding method shall have to be approved by the Engineer/ PIT and the finished weld shall be ground smooth to the exact head profile of the jointed rails. Should any weld prove defective either during the welding or later, a section of rail not less than 3 m long and with one end at least 300 mm clear of the defective weld shall be cut and a new portion of rail shall be welded in its place. In this regard all the cost shall be borne by the Contractor. The tolerances in line, levels and gauge of the rails shall meet the functional requirements of the proposed slipway.

9.4. Trial Installation

A trial Installation to determine an acceptable rail and base plate placing system and an acceptable grout system shall be carried out by the Contractor prior to commencement of the permanent work. Contractor shall include the cost for this trial installation at his contract rate for laying the track. The Contractor shall place a minimum length of 3.5 m of base plate and rail, complete with bolts, block outs etc. and shall demonstrate his proposed method of installation of the slipway rails. The trial grouting shall be carried out under the supervision of grout manufacturer, supplier and witnessed by the Engineer/ PIT. Contractor shall obtain the manufacturer's written approval for the procedure, as verified by the trial installation, prior to commencing the permanent work. The trial installation shall be designed to verify full grout penetration, the absence of air pockets and the absence of unsound areas No grouting of permanent works shall commence until the Engineer/ PIT gives the written approval for the installation method.

9.5. Measurement

(a) The rail shall be supplied and installed with necessary fittings and fixings of rails and all other components of the rail as per the Drawings and instruction of the Engineer/ PIT. Measurements will be done to confirm the

quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Contractor may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

9.6. Material properties:

- Tensile strength min 880mpa
- Elongation min 9%
- Chemical composition:

  C:0.65-0.76%
  Silicon: 0.15-0.35 %
  Mn: 1.1-1.4 %
  S: max 0.03%
  P: 0.03% (max)
  Cr: 0.25% (max)
  Ni: 0.25% (max)
  Cu: 0.25% (max)

9.7. Modified Design. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

07. TECHNICAL SPECIFICATION OF SLIPWAY CRADLE

1. General Description

The slipway cradle shall have the adequate structural strength to dock and undock the **vessels having light weight of 2500 Metric Tonne and maximum length of 120m in a 6.17-degree (1: 9.25) linear sloped** slipway. The Cradle shall be made of Marine grade structural steel which can endure the ship light weight and wheel rolling on the rail and free from all sorts of structural failure issues including buckling, bending and others. The full cradle system is divided into 3 parts as per following:

a. **Launching Cradle**: The Launching cradle will be used to dock and undock the vessel through the sloped rails of the slipway. The top of this cradle will be flat and the bottom will be aligned with the slipway slope.

b. **Intermediate Cradle**: The Intermediate cradle will be used to transfer the ship from the sloped railway to the horizontal rails. This cradle will be of same height throughout the length

c. **Side Transfer Cradle**: The Side Transfer cradle will be used to side transfer the ship from the horizontal rails to the rail tracks on Repair Facility. This cradle will be of same height throughout the length

2. Country of Origin. To be mentioned.

3. Country of Manufacture. USA, UK, Canada, Japan, Germany, France, Italy, Spain, South Korea, Turkey and China (To be mentioned)..

4. Year of Manufacture. 2024 or later. The item should be brand new and original.

5. Country of Assembly. Any country of manufacturer or Bangladesh (To be mentioned).

6. Technical Details

Each cradle should smoothly run on the rails so that no hindrance appears in the smooth working of the cradle system. The basic details of the proposed 3-part cradle system are as follows. The bidder shall prepare their detail design and drawing accordingly or propose alternative practical design (if needed).

There should have suitable locking mechanism in between each of the cradle for safe docking and undocking operation. Total length of the Launching and Intermediate

cradle is approx. 127m. The Launching and Intermediate cradle should be constructed in two continuous parts having length of 70m and 57m (approx.) to facilitate the docking and undocking operation of 120m vessels and other smaller vessels. The 70m cradles will be used for docking and undocking of smaller ships and the full-length cradles will be used for docking of 120m ships. There should have appropriate joining mechanism in between the 70m and 57m part of the cradles. Rails shall be installed on the Intermediate cradle for the movement of the Side Transfer Cradle along the Repair Facility direction.

The Side Transfer cradle should be constructed in split way using multiple smaller blocks so that its length can be adjusted according to the docking plan of different types of vessels. The side transfer cradle will remain on the Repair Facility underneath the vessels and the repair works will be done by keeping the vessels on the Side Transfer Cradle. However, wooden blocks need to be placed beneath the Side Transfer Cradle prior commencing the repair works so that the cradle wheels do not take any load while repair works are conducted. Minimum 100 tonne heavy duty marine grade hydraulic lifting jack should be considered to uplift different blocks of the Side Transfer Cradle and place wooden blocks beneath it. Minimum 05 (Five) Nos. of hydraulic jack shall be provided. Moreover, the wooden blocks shall be placed only on the beams of the rails as per drawing. No blocks shall be placed on nearby floor.

There shall be two sets of top cradles (Side transfer cradle) and each one will operate smoothly on their dedicated side rail lines in the Repair Facility. Moreover, another set of top cradles shall also be constructed having 50% (Fifty-percent) percent length. The unused blocks of the top Cradles will be used as spare or to dock a smaller ship on the slipway for emergency repair.

The deflections of the structural components of the 3 part cradle system should not hamper the smooth operation of the transfer and working process intended. The expected lifetime for the cradle system must be minimum 20 years.

7. Steel, Metalwork & Coatings

7.1.1. Structural steel for trolley

All weldable marine grade structural steel for hot rolled sections and plate shall comply with the requirements of ASTM Standard and shall be the grades of steel as specified hereinafter and on the Drawings. Details of the ladle analysis and the carbon equivalent of each particular grade shall be provided. All plates shall be cold flattened and no surface defects in any finished steel shall be corrected without the written permission of the Engineer. The minimum grade of structural steel, unless shown otherwise on the Drawings, shall be S 355. The Yield point will be should be 355 MPa and Tensile strength will be 470-630 MPa.

Chemical composition: C max 0.23, Mn max 1.6%, P max 0.05%, S max 0.05% and Si max 0.05%.

7.1.2. Cast steel for trolley wheel

Materials employed for solid wheels are largely restricted to unalloyed steels with a maximum carbon content of 0.56% and-after appropriate heat treatment, tensile strengths of at least 820 to 980 MPa in maximum.

Steel grade ER7 specifications: carbon content ≤ 0.52, yield strength ≥ 520 MPa, tensile strength 820-940 MPa, elongation ≥14% and V notch EN 13262 (-200 C) ≥10 J.

Chemical composition of the different steel grades according to the standard EN13262.

	Maximum Content in %[a]										
Steel Grade	C	Si	Mn	P[b]	S[b,c]	Cr	Cu	Mo	Ni	V	Cr + Mo + Ni
ER6	0.48	0.40	0.75	0.020	0.015	0.30	0.30	0.08	0.30	0.06	0.50
ER7	0.52	0.40	0.80	0.020	0.015	0.30	0.30	0.08	0.30	0.06	0.50
ER8	0.56	0.40	0.80	0.020	0.015	0.30	0.30	0.08	0.30	0.06	0.50
ER9	0.60	0.40	0.80	0.020	0.015	0.30	0.30	0.08	0.30	0.06	0.50

7.2. Testing

All steel to incorporate in the Permanent Work shall be subject to inspection and test. The test certificates shall relate to those routine tests performed at the mills and such other optional tests as specified hereinafter. Three copies of all works test certificates relating thereto shall be forwarded to the Engineer/ PIT by the Contractor. The Engineer/ PIT reserves the right to order or to carry out such tests as he may consider necessary. He can also select any number of plates from the lot and send it to competent Authority for necessary tests.

All steel ordered from the mills in one country for fabrication in some other country shall be stamped by the Inspecting Engineer/ PIT before shipment, and the cost of such stamping and of the laying out of material shall be borne by the supplier. The contractor shall submit brochures of their desired brand. The contractor may entertain the Engineer/ PIT to the country, where the plates are fabricated and approve the goods, before shipment. All costs regarding the Engineers/ PIT approval will be borne by as described in document A-02 (Terms and Conditions), paragraph 1.12 (FAT, PSI).

7.3. Hot Rolled Structural Steel Sections

Hot rolled structural steel sections shall comply with the ASTM code related to Structural Steel Section of Hot Rolled steel and also comply with the appropriate part of AASHTO code for the same. The Engineer's approval will ensure the product's certification.

7.4. Welding Consumables

7.4.1. General

All covered electrodes for manual arc-welding of steel structure shall comply with ASTM Standards related to Hot Rolled Products of structural steels & Technical delivery conditions. Moreover, the workmanship shall comply with the requirements

of ASTM Standards related to Welding terms and symbols (glossary for welding, brazing and thermal cutting etc.) All Electrode wires and fluxes, for the submerged arc welding of steel shall comply with the requirements of ASTM Standard for welding consumables. Filler rods and wires for gas-shielded arc welding shall comply with the requirements of ASTM Standards related to filler rods & wires for gas-shielded arc welding.

All welding consumables shall be of a type, size and quality approved by the Engineer/ PIT. Each batch of welding consumables shall be accompanied by the manufacture's certificate stating the date of manufacture, together with certificates giving the results of the initial tests and of the most recent periodic check test legible copies of which shall be supplied to the Engineer/ PIT.

7.4.2. Storage of Welding Consumables

All welding consumables shall be stored in their original unbroken bundles or packages in a warm, dry, clean and well ventilated palace. The Inspecting Engineer/ PIT shall have the access to there at all times. Under no circumstances shall electrodes be used in a damp condition. The electrodes should be cleaned time and time. Breakable electrodes should be kept in a safe place. Any electrodes described dirty, rusty or damaged by the Engineer/PIT shall have to be removed from the site.

7.5. Fabrication of structural Steelwork

7.5.1. General

All fabricated structural steelwork shall comply with the requirements of ASTM Standard for specification for materials, fabrication & erection of rolled and welded sections in respect of steel buildings, maritime structures and bridges, and with the additional requirements specified hereinafter. The Engineer/ PIT may permit otherwise.

7.5.2. Working up steel

No steel shall be worked up until the fabricators are in possession of satisfactory test certificates relating thereto.

7.5.3. Check for lamination

Where the design is such that transmission of tensile stress is required perpendicular to the face of any plate or rolled section, such locations shall be examined by the Contractor in the presence of the Inspection Engineer/ PIT, both visually and using ultrasonic testing equipment, for any signs of lamination. Any plates failing to pass the lamination test will be rejected and shall be replaced with sound material at no additional cost to the Employer.

7.5.4. Joints

No joints shall be made in any plate, bar, angle or other rolled section except where shown or described on the approved working drawings.

7.5.5. Assembling and Marking steelwork

The steelworks can only be started after the certification by the Engineer/ PIT and be assembled in the site area. The Engineer/ PIT shall have full access to the assembly site. Before dispatch from the fabricator's works all steelwork shall be cleaned and clearly marked or stamped to facilities sorting at the site, and the marking shall be in conformity with the approved working and erection drawings.

7.5.6. Packing for shipment

All cleats, gussets, stiffeners, brackets and other projecting material arising out of the fabrication shall be protected from damage while being transported and in such a manner as to prevent distortion. All machined surfaces shall also be protected. All straight bars, except small pieces, shall be shipped in bundles of convenient size and shall temporarily bolted together or bound with annealed steel wire not less than 65 millimeters diameter the satisfaction of the Inspecting Engineer/ PIT. All bolts, nuts, washers, screws, small pieces and other small articles shall be packed in crates or other suitable containers to the satisfaction of the Inspecting Engineer. Each pieces, package, bundle and crate shall be clearly marked with its weight and with the appropriate shipping marks before dispatch from the assembly site. Arrangements may change due to Clause 4.1.2.

7.5.7. Storage of Steelwork

All fabricated steel work, whether stored at the fabricator's works or at the Site, shall ensure that the steelwork is kept clear or the ground and the no pools of water or debris can collect upon the surface and each layer shall be separated from adjacent layers by stout timber battens or packing. In particular, zinc coated steelwork shall be kept dry and protected from windblown sand and dust.

7.6. Welding

7.6.1. General

No welds will be permitted in any part of the works except where shown or described on the approved working drawings. Weld symbols shall follow ASTM Standard of Welding terms and symbols.

The welding of steel shall be executed in accordance with provisions of ASTM Standard for specification for arc welding of carbon and carbon manganese steels.

All welds shall be of sound construction and of the dimensions shown on the Drawings or specified by the Engineer/ PIT. They shall be free from cracks and shall be of clean and regular appearance throughout. The execution shall be such as to ensure that the parts connected are properly aligned and positioned, free from distortion and so fixed together as to produce a homogeneous section of the correct dimensions. All welds shall be 100 percent visually inspected. The extent of no-destructive testing and the levels of acceptable defects shall be compatible with the service requirements of the welding. Welding should be done in both sides unless otherwise described by the Engineer/ PIT.

All butt welds shall be full penetration, all fillet welds shall be continuous and all joints shall be completely sealed unless otherwise specified by the Engineer/ PIT.

As much of the shop welding shall be executed by instrument of automatic or semi-automatic processes to the extent that the type of work and the dimensions thereof permit.

7.6.2. Welding Consumables

All welding consumables shall be used strictly in accordance with manufacturer's instructions so that the mechanical properties of the deposited metal shall not be inferior to those of the parent metal.

7.6.3. Welders to be Qualified

All welding, including tack welding, shall be performed by welders qualified for the specific types and categories of welding needed to be done for the project. They should know the handling and maintenance of welding consumables and equipment.

The contractor shall produce evidence that all welders are qualified as described above, but the Engineer/PIT shall be at liberty to require tests as he may deem appropriate to be carried out in his presence.

7.6.4. Welding Equipment

Equipment used for automatic, semi-automatic and manual welding shall be kept in good condition and shall be capable of maintaining at the fusion face the voltage and current specified by the manufacturer of the consumables. The Contractor shall measure the voltage, current, speeds etc. and verify compliance with the welding procedure as when required by the Engineer/ PIT.

The contractor shall provide welding standards for the various items of equipment showing bead sequence, travel speed, voltage and amperage.

7.6.5. Welding Procedures

The contractor shall be responsible for ensuring that all steel to be fabricated by welding is suitable for this purpose and that the welding consumables, workmanship, welding details and welding procedures adopted will produce satisfactory joints of the required strength and quality without incurring permanent distortion of the connected parts.

The contractor shall submit for the approval of the Engineer/ PIT his general programme for welding an shall include full particulars of his welding methods and procedures, as item wised in ASTM Standards for welding of carbon and carbon manganese, arc welding of tube-to-tube plate joints in metallic materials, general rules for tube welding, together with details of the preparation of fusion faces, the method of pre –heating where such is required and the type and size of electrodes. No fabrication or assembly involving any such methods and procedures shall be carried out until the Engineer/ PIT shall have given his approval and no departure from the approved welding procedures or from any details shown on the approved workings shall be made without his prior agreement in writing.

7.6.6. Welding Procedure Tests

Prior to the commencement of fabrication, welding and flame cutting procedure trials shall be carried out by competent personnel on typical examples of the various types and categories of welded members and joints using representative samples of the materials to be employed in the work; these trials shall demonstrate to the satisfaction of the Inspecting Engineer/PIT, the suitability and adequacy of the methods and procedure to be adopted in the fabrication.

The trials shall be representative of actual fabrications and shall include:-

(a) Welding process

(b) Parent metal specification

(c) Shop/site welding

(d) Cleaning

(e) Classification of welding consumables

(f) Welding consumables deposition details

(g) Plate weld preparation and fit-up details

(h) Joint restraint

The samples of the materials to be used in the aforesaid trials shall be selected and marked by the Inspecting Engineer/ PIT and the various types and categories of members and joints shall be welded in a manner simulating the most unfavorable conditions that will be experienced during fabrication or assembly.

After completing of welding the various samples shall be held at a temperature of not less than 100C for a period of not less than 72 hours and shall then be sectioned for subsequent examination and testing by the Contractor as may be required by the Inspecting Engineer/PIT.

7.6.7. Welding Fabrication

The unnecessary use of tack welding shall be avoided. Where tack welds are utilized, they shall be in accordance with the provisions of ASTM Standards for welding of carbon and carbon manganese. Any temporary attachments welded to the Permanent Works shall not be left in place or cut away from the surface of the Permanent Works to make it good.

In the fabrication of build-up assemblies, all But welds in each component shall be completed prior to final assembly of the individual components as far as it is practicable.

Where structural steelwork is required to be painted before fabrication or assembly, the metal surface within 75 mm of any weld preparation shall be coated with a prefabrication or blast prime coat only.

Useless otherwise specified hereinafter or indicated on the Drawings, all necessary connections shall be provided with continuous seal welds recommended by the Engineer.

7.6.8. Weld Testing

During the course of fabrication, the Engineer shall be entitled to call for such samples to be prepared and submitted for examination and testing as he may consider necessary. The Contractor shall be responsible for the preparation and testing of all welded test pieces, as and when required by the Engineer, and for the provision, maintenance and efficiency of all apparatus and equipment necessary to the conducting of such tests or take it to competent authority at his own expenses.

7.6.9. Non-Destructive Testing of Welds

In addition to any other testing required by this Specification non-destructive testing of welds on completed members and joints may be carried out by the Engineer's Representative or the Inspecting Engineer during the course of fabrication as required and any length of weld or any welded joints exhibiting cracks shall be rejected and such defective welds shall be cut out and re-welded. Flaws, porosity, slag inclusion, undercutting and any other defects which impair the required strength and /or the required service of the welds shall be cut out and made good. The Contractor shall bear the entire cost of making well or replacing any such rejections.

The Contractor shall be responsible for all preparations necessary to the carrying out of non-destructive testing of welds on completed members and joints to the satisfaction of the Engineer and shall provide all assistance required for the conducting of such tests, All costs and charges in connection with the handling, transporting, setting up, dismantling and removal of all members and joints required for non-destructive testing, including attending on the Engineer throughout the periods of testing, shall be covered by the contractor.

7.6.10. Weld Rectification

Any approval by the Engineer/ PIT of the welding methods and procedures shall in no way limit or restrict the right and authority of the Engineer's Representative or the Inspecting Engineer to reject subsequently any welds or welded joints that, in his opinion, fall below the standard appropriate to the class of work, Any welds or welded joints so rejected shall be cut out by the steelwork fabricator and replaced with sound work.

7.7. Bolts, Nuts and Washers

7.7.1. General

All bolts, nuts and washers shall comply with the requirements of the under mentioned British/ ASTM Standards as appropriate and with such additional requirements as specified hereinafter.

7.7.2. Black Blots and Nuts

Black bolts and nuts shall be in accordance with ASTM Standard and certified by the Engineer/ PIT. Bolts shall be strength Grade 4.6 and nuts shall be Grade 4.

7.7.3. Precision Bolts and Nuts

Precision bolts and nuts shall be in accordance with ASTM Standard and certified by the Engineer/ PIT. Bolts shall strength Grade 8.8 and nuts shall be Grade 8.

7.7.4. Washers

Flat and taper steel washers shall be in accordance with ASTM Standard and certified by the Engineer. Washers shall be provided under the nuts of all black bolts and precision bolts so that the nut, when screwed up tight, does not bear on the shank of the bolt. Taper washers of the correct angle of taper shall be provided under all bolt-heads and nuts that are required to bear on beveled surfaces.

7.7.5. Anchor Bolts and Nuts

Anchor bolts and nuts for setting in concrete shall be supplied by manufactures approved by the Engineer/ PIT and shall be fixed in accordance with the manufacturers' instructions. The contractor shall supply to the Engineer/ PIT three copies of the manufacturer's technical information sheets giving full particulars of the bolts, the safe working loads and the method of fixing and usage.

7.7.6. Erection of Structural Steelwork

The erection of structural steelwork at the Site shall comply with ASTM Standard for specification for use of structural steel in Building, use of materials, fabrication & erection: hot rolled steel and steel, concrete & composite bridges: Materials & workmanship and be in accordance with the recommendations of ASTM code for practice for safety in erecting structural frames. When lifting and fitting steelwork into position care shall be taken that the parts thereof are not strained, twisted, bent or damaged, they shall be rectified in such manner as the Engineer's/ PIT's Representative may direct by gentle heating and pressure and not by hammering. Any parts that are, in the opinion of the Engineer's/PIT's Representative, too badly damaged for rectification in the manner aforesaid shall be replaced by new material. All rectification and /or replacement shall be at the Contractor's expense.

The stacking of structural steelwork or the individual parts thereof on the Site in a manner or in such position as may, in the opinion of the Engineer's/PIT's Representative, cause damage to any of the members or parts thereof or to any portion of the Permanent Works will not be permitted.

Proper and suitable slings, blocks, tackles, shear legs, derricks, canes and other types of lifting appliance and equipment shall be provided, whenever necessary for the erection of the structural steelwork and the use of all such Contractor's specifications shall be in accordance with the recommendations of ASTM Codes. Every care and precaution shall be taken to ensure the safety of persons engaged in

such work and to prevent damage to any steelwork in the construction erected or already erected or to any part of the Permanent Works for the results of any mishap, failure, breakdown or other accident to any of the aforesaid lifting appliances and equipment. The lifting of steelwork in bundles or in such quantities or in any manner, which in the opinion of the Engineer's/PIT's Representative, is liable to cause damage or strain or is in any way considered to be insecure or unsafe will not be permitted.

7.8. Surface Preparation

7.8.1. General

All surface defects likely to be detrimental to the protective coating system shall be removed as laid down in ASTM Standard for weldable structural steel. All fins at saw cuts, burs and sharp edges shall be similarly removed.

7.8.2. Mechanical Cleaning

Mechanical cleaning shall be carried out by means of power-driven tools, such as carborundum grinding discs, chipping hammers, needle guns, etc. followed by steel-wire brushing and dusting with stiff bristle brushes to remove all loosened material. Excessive burnishing of the metal though prolonged application of steel-wire brushes will not be permitted.

The surface finishes after mechanical cleaning shall correspond to ASTM Standard for steel substrates before application of paints and related products.

7.9. Metal Coatings

7.9.1. Galvanizing

All materials to be galvanized shall be of the full dimensions specified and all drilling, welding, etc. shall be carried out before galvanizing. All items shall be cleaned and degreased and acid pickled before galvanizing.

All galvanizing shall be carried out by the dip process as specified in ASTM Standard and the weight of coating shall be not less than that described there.

All box members shall have vent holes, which shall be filled with suitable galvanized plugs after the galvanizing process.

7.9.2. Inspection and Testing

All galvanizing and metal spraying will be subject to examination by the Inspecting Engineer/ PIT both during and after manufacture and shall be tested in his presence in accordance with the provisions of the aforesaid ASTM Standards.

7.9.3. Repairs to Damaged Coating

Any areas of metal-coated surface which, before dispatch, are damaged or have in any way deteriorated shall be rubbed down to remove excessive roughness and thoroughly cleaned and a coat of zinc-rich or aluminum printing paint applied to the affected areas thereafter as appropriate.

7.10. **Modified Design**. Please note that bidders may propose modified design with justification based on the provided preliminary design within the quoted price, which will be evaluated by Tender Evaluation Committee. Such proposal must fulfil the purpose of the Slipway; i.e., docking and undocking of ships of 2500 LWT.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

General Arrangement and Engineering Design of Facilities

Document Code: CW-01

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
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Dhaka 1000, Bangladesh

April 2025

Table of Contents

List of Abbreviations

ASTM	American Society for Testing and Materials
BDS	Bangladesh Standard
BNBC	Bangladesh National Building Code 2020
BNS	Bangladesh Naval Ship
BRTC	Bureau of Research, Testing and Consultation
BUET	Bangladesh University of Engineering and Technology
CD	Chart Datum
CEM	Cement
EN	European Norm
ISO	International Standards Organization
MS	Mild Steel
PVC	Polyvinyl Chloride
RCC	Reinforce Cement Concrete
RC	Reinforced Concrete
SS	Stainless Steel

CHAPTER 1 SLIPWAY

1.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Primarily Reinforced Concrete (RC) facility.

General arrangement plan and design: As per drawings

1.2 STRUCTURAL DESIGN SPECIFICATIONS

Design Code: Bangladesh National Building Code 2020 (BNBC-2020). In addition, other international marine design and construction codes as accepted by the Owner can be followed.

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 7

Importance Factor (Earthquake): 1.5

Occupancy Category: IV, Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust), Wind exposure category: C

Importance Factor (Wind): 1.15

1.3 DESIGN LOADS

Working Live Load at level +5.5m (CD): 50 kN/m^2 average all over plus a point (wheel) load of 500 kN over an area of 600mm x 600mm at random location. Load on cradle rail shall be as per the design ship (120m long ship having 2500 ton LWT to be launched and berthed). Working live load on the sloped part shall be average 5.0 kN/m^2 all over.

1.4 FOUNDATION TYPE:

Precast pile foundation with pile-cap-beam, pile length 18m and others, size 400x400mm, allowable capacity: 45.0 ton in compression and 15.0 ton in uplift.

1.5 MATERIALS

Reinforcement: BDS ISO 6935-2:2021 Grade B500DWR

	TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Fine aggregate:	i) Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. ii) Local sand of F.M.≥ 1.0 shall be used for non-structural components e.g. plastering, floor finish etc. iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components. TESTS: i) Sieve analysis, ASTM C136-14.

Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

1.6 SLIPWAY RAIL

The slipway rail material shall be in accordance with the drawings and specification provided elsewhere in the tender documents. The supplier shall need to propose a detailed design of the anchoring system to firmly hold the rail on the rail-beam all the time. The anchoring system shall be such that the rails can be dismantled at the end of their service life and new rails can be installed at the same position with proper anchoring to the concrete of the rail-beam. Such replacement process shall not cause any structural damage to the rail-beam. The details of the anchoring system must be approved by the buyer prior to the commencement of the construction of slipway.

1.7 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional design and construction specifications as applicable.

CHAPTER 2 WINCH CONTROL FACILITY

2.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Reinforced Concrete Facility.

General arrangement plan and design: As per drawings

Others:

a) Outer Wall: All outer walls will be 125 or 250mm thick brick wall with plaster finish or ceramic cladding (with 50x50x200mm red clay ceramic blocks).

b) Inner Wall: All inner walls will be 125mm thick brick wall with 12mm thick plaster finish. A 150mm high skirting shall be provided at the bottom of all plastered walls (where wall tiles are not used). The skirting material shall be the same as the nearby floor tile material.

c) Floor Finish (1F and above): Matte polished homogeneous ceramic 600mm × 600mm floor tiles on floors except toilets. Homogenous floor tiles 400mm × 400mm for pantries. Matte finish ceramic tiles 600mm × 600mm floor tiles in toilets except sailor's. Matte finish ceramic tiles 400mm × 400mm floor tiles in sailor's toilets. 250mm × 400mm wall tiles in sailor's toilets. 600mm × 300mm wall tiles on GM toilets.

d) False Ceiling: Gypsum board ceiling with aluminum framing with proper design.

e) Window: All windows will be sliding type with clear glass of appropriate thickness (min. 6mm) framed in powder coated aluminum section frames of appropriate size and thickness (imported). Bathroom windows will be fixed and casement type. The windows shall be capable to withstand the pressure due to design wind load in accordance with the BNBC 2020 provisions.

f) Stair Railing: SS Railing as per design.

g) Veranda Railing: Combined with tempered Glass Railing & RCC low-wall railing as per design.

h) Ground Floor Pavement: Ground floor parking level will be 300mm × 300mm concrete tiles.

i) Ground Floor Plinth: Heavy duty matte finish industrial floor tiles of size 300mm × 300mm.

j) Glass Partition: All internal Glass partitions will be 10 mm thick tempered frame less glass with SS accessories.

k) Glass Door: All internal Glass doors will be 10mm thick tempered frame less glass with SS accessories.

l) Wooden Door: Veneered particle flash door with water proof.

m) Common Bathroom Partition: PVC board partition with SS accessories and indication of occupation.

n) Louvre: 50 × 100mm box aluminum metal louvre.

o) Painting:

   i. Cement based weather coat painting on exterior plastered surface.

   ii. Water repellant membrane coating on all ceramic clad surface

   iii. Plastic emulsion paint of approved color on interior plastered walls and ceilings.

2.2 STRUCTURAL DESIGN SPECIFICATIONS

Facility type: Special Reinforced Concrete Moment Frame Facility.

Design Code: Bangladesh National Building Code 2020 (BNBC-2020)

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 7.0 or less

Importance Factor (Earthquake): 1.5

Occupancy Category: IV

Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust)

Importance Factor (Wind): 1.15

Wind exposure category: C

2.3 FLOOR DESIGN LOADS:

Gr. Floor: Floor Finish: 1.5 kN/m^2, Partition Wall: 2.0 kN/m^2, Live Load: 2.0 kN/m^2

1st Floor: Floor Finish: 1.5 kN/m^2, Partition Wall: 4.0 kN/m^2, Live Load: 3.0 kN/m^2

Roof: Floor Finish: 1.5 kN/m^2, Partition Wall: 0.5 kN/m^2, Live Load: 1.25 kN/m^2

Stair: Floor Finish: 2.0 kN/m^2, Live Load: 5.0 kN/m^2

Toilet: Floor Finish: 1.5 kN/m^2, Partition Wall: 4.0 kN/m^2, Live Load: 1.0 kN/m^2

2.4 FOUNDATION TYPE

Suggested: Individual or combined RC spread footing.

2.5 MATERIALS

Reinforcement:	BDS ISO 6935-2:2021 Grade B420DWR TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.

Fine aggregate:	i) Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. ii) Local sand of F.M.≥ 1.0 shall be used for non-structural components e.g. plastering, floor finish etc. iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components. TESTS: i) Sieve analysis, ASTM C136-14.
Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

2.6 WINCH ROOM

The front of the winch rooms (operating side) shall have metal rolling shutter. All these shall be installed in such a manner that the winch machineries are fully protected from weather while not in operation.

2.7 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional relevant design and construction specifications as applicable.

CHAPTER 3 SECURITY MONITORING SYSTEM, PUMP & BLASTING SYSTEM, GENERATOR, ELECTRO-MECHANICAL & FIRE PUMP SYSTEM

3.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Reinforced Concrete Facility.

General arrangement plan and design: As per drawings

Others:

a) Outer Wall: All outer walls will be 125mm thick brick wall with plaster finish.

b) Inner Wall: All inner walls will be 125mm thick brick wall with plaster finish.

c) Floor Finish: Industrial Epoxy Floor Finish on ground floor of pump and blasting room, matte or non-glossy finish 400mm ×400mm floor tiles for guard house, 300mm × 300mm tiles on toilet floors and walls.

p) Window: All windows will be sliding type with clear glass of appropriate thickness (min. 6mm) framed in powder coated aluminum section frames of appropriate size and thickness (imported). Bathroom windows will be fixed and casement type. The windows shall be capable to withstand the pressure due to design wind load in accordance with the BNBC 2020 provisions.

d) Stair Railing: SS Railing as per design.

e) Veranda Railing: Railing and grill with painted MS box sections.

f) Wooden Door: Veneered particle flash door with water proof painting.

g) Main Door: Wooden door.

h) Painting: Cement based weather coat painting on all exterior plastered surface, Plastic paint on interior plastered walls and ceilings.

3.2 STRUCTURAL DESIGN SPECIFICATIONS

Facility type: Reinforced Concrete Moment Framed Facility.

Design Code: Bangladesh National Building Code 2020 (BNBC-2020)

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 7.5 or less

Importance Factor (Earthquake): 1.5

Occupancy Category: IV

Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust)

Importance Factor (Wind): 1.15

Wind exposure category: C

3.3 FLOOR DESIGN LOADS:

Gr. Floor: Floor Finish: 1.5 kN/m^2, Partition Wall: 2.0 kN/m^2, Live Load: 2.0 kN/m^2

1st Floor: Floor Finish: 1.5 kN/m^2, Partition Wall: 4.0 kN/m^2, Live Load: 3.0 kN/m^2

Roof: Floor Finish: 1.5 kN/m^2, Partition Wall: 0.5 kN/m^2, Live Load: 1.25 kN/m^2

Stair: Floor Finish: 2.0 kN/m^2, Live Load: 5.0 kN/m^2

Toilet: Floor Finish: 1.5 kN/m^2, Partition Wall: 4.0 kN/m^2, Live Load: 1.0 kN/m^2

3.4 FOUNDATION TYPE

Suggested: Individual RC spread footing.

3.5 MATERIALS

Reinforcement:	BDS ISO 6935-2:2021 Grade B420DWR TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain

	good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Fine aggregate:	i) Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. ii) Local sand of F.M.≥ 1.0 shall be used for non-structural components e.g. plastering, floor finish etc. iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components. TESTS: i) Sieve analysis, ASTM C136-14.
Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

3.6 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional design and construction specifications as applicable.

CHAPTER 4 REPAIR FACILITY

4.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Reinforced Concrete (RC) facility.

General arrangement plan and design: As per drawings

4.2 STRUCTURAL DESIGN SPECIFICATIONS

Design Code: Bangladesh National Building Code 2020 (BNBC-2020)

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 8

Importance Factor (Earthquake): 1.5

Occupancy Category: IV, Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust), Wind exposure category: C

Importance Factor (Wind): 1.15

4.3 DESIGN LOADS

Working Live Load at levels +5.5, +6.0m and +6.5m (CD): 50 kN/m^2 average all over plus a point (wheel) load of 500 kN over an area of 600mm x 600mm at random location. Load on cradle rail shall be as per the design ship (120m long ship having 2500 ton LWT to be launched and berthed). Load capacity of the keel supporting beam shall be same as the cradle rail beams.

4.4 FOUNDATION TYPE:

Precast pile foundation with pile-cap beam, pile length 18m, size 400x400mm, allowable capacity: 45.0 ton in compression and 15.0 ton in uplift.

4.5 MATERIALS

Reinforcement: BDS ISO 6935-2:2021 Grade B500DWR

	TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Fine aggregate:	i) Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. ii) Local sand of F.M.≥ 1.0 shall be used for non-structural components e.g. plastering, floor finish etc. iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components. TESTS: i) Sieve analysis, ASTM C136-14.

Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

4.6 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional design and construction specifications as applicable.

CHAPTER 5 PAVEMENT AND DRAINAGE

5.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Reinforced Concrete (RC) facility.

General arrangement plan and design: There are two types of pavements –

a) Heavy-duty pavement (or hard standing area) and

b) Light-duty pavement

Details of the pavement plan and design are available on the drawings.

5.2 STRUCTURAL DESIGN SPECIFICATIONS

Design Code: Bangladesh National Building Code 2020 (BNBC-2020)

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 8

Importance Factor (Earthquake): 1.5

Occupancy Category: IV, Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust), Wind exposure category: C

Importance Factor (Wind): 1.15

5.3 DESIGN LOADS

5.3.1 Heavy-duty pavement

Working Live Load: 50 kN/m^2 average all over plus a point (wheel) load of 500 kN over an area of 600mm x 600mm at random location.

5.3.2 Light-duty pavement

Working Live Load: 20 kN/m^2 average all over plus a point (wheel) load of 100 kN over an area of 600mm x 600mm at random location.

5.4 FOUNDATION TYPE

5.4.1 Heavy-Duty Pavement

The soil beneath the heavy-duty pavement shall be improved by removing the existing top 500mm soil, installing sand compaction piles of diameter 200mm and spaced 600mm on center in all direction, back filling the ground in multiple compacted layers with backfilling sand, laying of the granular sub-base layer and then constructing the RC pavement (with wearing course layer, if any) to the desired level. The sand compaction piles shall be installed by displacement method following the methodology and specification provided elsewhere in the tender documents and drawings. Bearing capacity at the top of the sub-base layer should be sufficient enough to support the design loading with adequate factor of safety.

5.4.2 Light-Duty Pavement

The soil beneath the light-duty pavement shall be improved by removing the existing top 500mm soil, back filling the ground in multiple compacted layers with backfilling sand, laying of the granular sub-base layer and then constructing the RC pavement (with wearing course layer, if any) to the desired level. Bearing capacity at the top of the sub-base layer should be sufficient enough to support the design loading with adequate factor of safety.

5.5 DRAINAGE SYSTEM

Rain and other surface water drainage system of the open yard consists of U-drains located on the edges of the pavement. Layout of the drainage system and their structural detailing are shown on the drawing sheets.

5.6 MATERIALS

Reinforcement:	BDS ISO 6935-2:2021 Grade B500DWR TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mmfor all works except the RC wearing course. All

	coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). For the RC wearing course, the maximum aggregate size shall be 12mm. TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Fine aggregate:	i) Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. ii) Local sand of F.M.≥ 1.0 shall be used for non-structural components e.g. plastering, floor finish etc. and for the sand compaction piles. iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components. TESTS: i) Sieve analysis, ASTM C136-14.
Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Brickwork:	Using first class bricks with 1:4 cement mortar joints. Others as per drawings.

Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

5.7 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional design and construction specifications as applicable.

CHAPTER 6 DOLPHIN STRUCTURE

6.1 GENERAL ARRANGEMENT SPECIFICATIONS

Facility type: Primarily Reinforced Concrete (RC) facility.

General arrangement plan and design: As per drawings

6.2 STRUCTURAL DESIGN SPECIFICATIONS

Design Code: Bangladesh National Building Code 2020 (BNBC-2020). In addition, other international marine design and construction codes as accepted by the Owner can be followed.

Seismic Zone: 1, Zone Co-efficient, Z: 0.12

Response Reduction Factor, R: 7

Importance Factor (Earthquake): 1.5

Occupancy Category: IV, Site Class: SD

Seismic Design Category: D

Wind Speed: 73.9 m/s (3-sec gust), Wind exposure category: C

Importance Factor (Wind): 1.15

6.3 DESIGN LOADS

a) Working live load on the jetty: 10 kN/m^2 average gravity load all over plus a point load of 20 kN over an area of 600mm x 600mm at random location. I

b) The horizontal service pull on the capstan from the ship must be considered with a safety factor of 5.0 (five).

c) The jetty shall be capable of withstanding minimum ship impact load and wave actions. The contractor shall verify and approve these loads with the buyer/owner before finalizing the design of the dolphin.

d) Reaction load form the causeway shall also be considered.

6.4 FOUNDATION TYPE:

Raked precast pile foundation with pile-cap-beam, pile length as indicated on the drawings, size 450x450mm, allowable capacity: 30.0 ton in compression and 25.0 ton in uplift.

6.5 MATERIALS

Reinforcement:	BDS ISO 6935-2:2021 Grade B420DWR TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Deformation measurement.
Concrete:	Specified compressive strength of concrete for Precast piles: C40 (f'_c = 40MPa) min Other structural components: C35 (f_c' = 35MPa) min Mix design as per BNBC-2020.
Coarse aggregate:	Crushed natural stone chips with maximum size of 20mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B). TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Fine aggregate:	Sylhet sand of F.M.>2.5 shall be used for all structural components e.g. mat, column, lift core, shear wall, basement wall, beam, slab, stair, water tank etc. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification for structural components.

	TESTS: i) Sieve analysis, ASTM C136-14.
Cement:	As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N
	TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.
Water:	Water used in mixing concrete shall be clean and free from injurious amounts of oils, alkalies salts, organic materials or other substances that may be deleterious to concrete or reinforcement. Water shall conform to the following standards: BDS ISO 12439:2011 Mixing water for concrete.
Admixture:	As per BNBC-2020 Sec. 2.3.5, Chapter 2, Part 5.

6.6 CAPSTAN AND OTHERS

The capstan shall be installed at the center of the top platform. Anchoring of the capstan to the concrete base shall be just adequate enough to develop the required horizontal pull force on the capstan.

6.7 CAUSEWAY

Each dolphin shall be connected to the nearest hard standing area by means of a steel structure causeway. The walkway width of the causeway shall be 1.50m min. Span shall be as shown on the drawings. There shall be min. 1.0m high structural steel railing along the walkway on both sides. Structural steel sections such as wide flange sections, channels, angles etc. shall be used to construct the causeway. Material grade for the structural steel, except the chequered MS plates, shall be ASTM A570 Grade 50 or equivalent. The walkway floor shall consist of chequered MS plates (with ASTM A36 material) fitted on other framing members. Connections shall be bolted and/or welded. Structural bolts ASTM A325 or equivalent shall be used. All structural steel components, nuts, bolts and washers etc. shall be hot dipped galvanized with min. 110-micron zinc thickness. The min. live load on the causeway shall be 5.0 kN/m^2.

6.8 OTHER SPECIFICATIONS

Please see other tender specification documents CW-02, CW-3, CW-04 and CW-05 as well as the tender drawings for additional design and construction specifications as applicable.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Facilities Installation andCommissioning Part-1 of 2

Document Code: CW-02

Prepared by

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April 2025

PREFACE

This document CW-02 is provided to assist installation of various facilities. Specifications provided in this document shall be followed unless more specific information is provided in the drawings or elsewhere in the tender documents. In case of any conflicting scenario across the tender documents regarding technical specifications, the decision of the buyer/owner shall be final.

Table of Contents

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	Air Conditioning
ACI	American Concrete Institute
ACV	Aggregate Crushing Value
AISC	American Institute of Steel Construction
AISI	American Ironand Steel Institute
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BDS	Bangladesh Standards
BN	Bangladesh Navy
BNBC	Bangladesh National Building Code 2020
BNS	Bangladesh Naval Ship
BOQ	Bill of Quantities
BRTC	Bureau of Research, Testing and Consultation
BS	British Standard
BSTI	Bangladesh Standards and Testing Institute
BTCL	Bangladesh Telephone Company Ltd.
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBR	California Bearing Ratio
CC	Cement Concrete
CD	Chart Datum
CPM	Critical Path Method
CUET	Chittagong University of Engineering and Technology

DOE	Department of Environment
DPC	Damp Proof Course
DWT	Dead Weight Ton
EN	Euro Norm
EPC	Engineering, Procurement and Construction
FM	Fineness Modulus
FI	Flat Iron
GI	Galvanized Iron
GP	Galvanized Plain
GCC	General Condition of Contract
IS	Indian Standard
ISO	International Standards Organization
IWM	Institute of water Modeling
KW	Kilo Watt
LAA	Los Angeles Abrasion
LWT	Light Weight Ton
MAF	Movement Accommodation Factor
MS	Mild Steel
NAME	Naval Architecture and Marine Engineering
PDF	Portable Document Format
PIT	Project Implementation Team (of the Owner)
PVC	Polyvinyl Chloride
RCC	Reinforced Cement Concrete
RC	Reinforced Concrete
SPT	Standard Penetration Test
STP	Standard Test Procedure, Roads and Highways Department, 2001
SWG	Standard Wire Gauge

CHAPTER 1 GENERAL AND SITE FACILITIES

1.1 INTRODUCTION

1.1.1 Scope of General Information

The term specification, wherever referred in this or other sections, will indicate both general and particular specifications, if not particularly specified.

1.1.2 Location of the Facility to be Developed

BNS Mongla, Digraj, Mongla, Bagerhat, Bangladesh, which is situated at the east bank of Pusur River.

1.1.3 Extent of Works

The following is a brief list of major works, but not limited to, are to be executed for the subject contract-

a. Site Survey

b. Geotechnical Subsoil Investigation

c. Clearing of Site and Establishing Site Offices

d. Slipway Installation

e. Installation of Repair Facility

f. Installation of Dolphin

g. Installation of Winch with Control and Power System

h. Installation of Security Monitoring System

i. Pump and Blasting System

j. Heavy-duty (hard standing area) and light-duty pavement

k. Supply of Auxiliary Items for Administrative Works

l. Supply of Machineries and Equipment.

Details of the scope of supply are given in the “Introduction and Scope” (document code A-01) as well as in the drawings.

1.1.4 Drawings

The bidder/supplier shall perform their own analysis and design calculations and prepare detailed shop/fabrication drawings based on their own analysis. In such a case, the analysis and design calculations must be in accordance with the technical specifications provided in documents CW-01, this document, CW-03, CW-04 etc.) which are provided as part of this tender document. In any case, the supplier may not change any architectural layout, plan or feature of the structures such as the location of the proposed facility, general floor plans, column locations, locations of stairs, floor height, room arrangements, interior and exterior architectural design features etc. The supplier shall also submit detailed design calculation report with each item thus designed. Design of the structures thus performed by the supplier must be approved by the Engineer/PIT before being adopted for construction. The bidder shall remain fully and solely responsible of the final design and drawings for the project.

1.1.5 Mobilization

The Bidder shall mobilize all necessary manpower, plants and equipment for the execution of the project. The following major equipment shall be mobilized at site for execution of the project.

a) Excavator
b) Dump truck
c) Concrete Batching and mixing plant
d) Piling set
e) Hoist
f) Generator
g) Leveling set with accessories
h) Pump set (Diesel / Electrical) - 4 sets

In addition to the above equipment, other required equipment and accessories, including laboratory and survey equipment, needed for the work shall have also to be mobilized.

1.2 ESTABLISHMENT OF BIDDER'S FACILITIES

1.2.1 Bidder's Working Area

a) The Bidder shall work in a designated area within the site of the project area. The Bidder shall hire at his own expense any additional work area, if needed, for the

execution of the work. The Bidder will, if necessary, raise the existing level of the areas as per direction of the Engineer /PIT /Consultant. This area shall provide the space for storage, parking of vehicles, offices, workshops, plants, laboratory, prefabrication facilities and the like.

b) The Bidder shall dispose off at his surplus spoils or the like at a place as directed the Engineer /Consultant /PIT.

c) The Bidder shall provide, erect, construct, and equip offices, accommodation, workshops, stores, loading and unloading facilities, prefabrication yards and other areas for his staff, personnel and constructional equipment required by them directly or indirectly for the construction, completion and maintenance of the work.

d) The Bidder shall submit for the prior approval of the Engineer /PIT/Consultant, his proposal for layout of his working area and other facilities. The Bidder shall locate in consultation with the Engineer /PIT, the aggregate crusher and concrete batching plant at such location that they do not pollute the environment and cause obstruction to the normal functioning of activities within and outside the project area.

e) The Bidder shall provide provision for adequate drainage within the area. The Bidder shall provide adequate parking area, stockyard and other necessary facilities. The Bidder shall submit the detailed plan, design and drawings of individual structures (site office, stores, workshops, other buildings and structures) for the approval of the Engineer /PIT/Consultant.

The Employer reserves the right to modify later the site or location or design of the facilities within the proposed work area, if during operation of the facilities the Employer finds that Bidder's operation is causing problems to the work and to the environment of the surrounding area. He will notify the Bidder accordingly and instruct the Bidder to take appropriate steps, which may include shifting or relocating some of his facilities within the demarcated area or the newly selected area. Within 14 days of the receipt of such notice and instruction, the Bidder shall comply with the instruction at his own expense.

1.2.2 Site Clearance

If demolition is required, the Bidder shall demolish these as per drawing and to the satisfaction of the Engineer /PIT/Consultant. The materials dismantled shall be owned and removed by the Bidder outside the site, with the approval of PIT.

1.2.3 Removal of Offices and Accommodation

The Bidder, at the completion of the project, shall be required to demolish and remove outside the offices and accommodation provided by them and other and used during the work. All salvaged material will be the property of the Bidder and have to be removed outside the site.

1.2.4 Possession

The Bidder will be given possession of the site allocated for his temporary use and the execution of the works in accordance with the provision of the Contract.

1.2.5 Access

The Bidder shall be entirely responsible for providing all access to the site for personnel materials supplies, vehicles and plant and for all other requirements of the works.

The Bidder shall abide by all limitations, laws and regulations relating to the use of public transportation routes and waterways, and shall be responsible for any damage caused by his misuse of them.

The bidder should require any other form or route of access not provided for by the contract, he shall make his own arrangements, obtain any necessary permission, and be solely responsible for payment of any payment of any costs, charges for compensation in connection therewith.

1.2.6 Security

The Bidder shall be responsible for maintaining appropriate security in his working area at his own cost.

The Bidder's responsibility for the security and safe working environment of the site commences from the time of possession given to them by the Employer.

As soon as possible after possession has been given, the boundary of the site shall be marked out, and the Bidder shall submit to the Engineer /PIT for approval, his proposals for maintaining the boundary and the security within.

The Bidder's proposals shall include a security control system which shall consist of sufficient equipment and personnel to prevent unauthorized access and which can meet the prevailing circumstances to ensure the safety security of persons and property on the site.

The bidder shall erect and maintain at his own expense suitable and approved temporary fencing and gates to enclose certain areas of the works being carried out, the office and accommodation compounds, and other areas of land as may be necessary to implement his obligations under the Contract or as directed by the Engineer /PIT. All authorized persons shall be registered by the Engineer /PIT, and this register shall be provided and maintained by the Bidder.

1.2.7 Cleanliness and Reinstatement

The Bidder shall throughout the period of construction of the works maintain the whole area of his operations in a clean, tidy and safe condition by arranging his materials and equipment in an orderly manner. All rubbish, waste material, debris and the like shall be systematically cleared off the working areas as it accumulates and removed directly off the site by the Bidder at his own cost.

The Bidder shall, immediately upon completion of any work and following the approval of the Engineer /PIT, fill up all holes and trenches which may have been made or dug, level any mounds made and clear away all rubbish which may have been occasioned or made in the execution of the works.

1.2.8 Disposal and Pollution

The Bidder shall not dispose of any waste, rubbish or offensive matter in any place not approved by the Engineer /PIT or Statutory Authority having jurisdiction. The Bidder shall not discharge into any water recourse oil, solids, and noxious or floating materials.

The Bidder shall take all reasonable precautions to keep public or private roads clear of any spillage or droppings from his vehicles and equipment. Any spillage or droppings, which accrue, shall be cleared without delay to the satisfaction of the Engineer /PIT/Consultant.

1.2.9 Health and Safety

a) The Bidder shall observe and maintain standards of Health and Safety towards all of his employees not less than those laid down by his own national standards or statutory regulations.

b) He/She should take all reasonable steps including training and safety drill to ensure that the safety of all persons on the site, whether in his employment or not, in paramount.

c) The Bidder shall provide all appropriate protective clothing and equipment for the work to be done and ensure its proper use. Where required safety nets, belts harnesses and lines shall be provided by the Bidder.

d) The Bidder shall provide and maintain in prominent and well-marked positions all necessary first-aid equipment, medical supplies and other facilities. A sufficient number of trained personnel will be required to be available at all times to render first aid.

e) A suitably equipped room will be made available with beds and stretchers for emergency medical treatment, and a planned system for removal to hospital for authorized per sons requiring further treatment will be provided by the Bidder.

f) The Bidder shall report to the Engineer /PIT promptly and in writing particulars of any accident or unusual or unforeseen occurrences on the site, whether likely to affect progress of the work or not.

1.2.10 Temporary Works

The Bidder shall be responsible for design, specification, execution and subsequent removal of all Temporary Works necessary for the efficient completion of the works. Before the Bidders starts construction on any part of the Temporary works, he shall furnish to the Engineer /PIT complete drawings and if so required, calculations relating to strength of that Temporary works. Where the Temporary Works have direct contact with any part of the Permanent Works, the drawings and calculations shall clearly indicate the relationship, illustrate erection sequences and show any loading or stresses applied to or from the Permanent works.

The required submission of drawings and/or calculation shall be made to the Engineer /PIT a reasonable period before the Bidder intends to commence any fabrication or installation of Temporary Works. The Bidder shall make due allowance in his program for submission of temporary works proposals, review by the Engineer /PIT and amendment, resubmission and further review by the Engineer /PIT as may be necessary until the consent of the Engineer /PIT to the proposals is obtained.

The furnishing of any drawings and calculation of the Temporary works to the Engineer /PIT shall not relieve the Bidder of any liability or obligation under the contract in respect of such temporary works.

1.3 FACILITIES FOR THE ENGINEER /PIT

The Bidder shall provide and maintain the following temporary site office for the BN representative (Project Implementation Team-PIT), Engineer/Consultant and their Representatives-

a) The total floor area of the Engineer's office shall be 120 sq.m approximately.
b) The office is suggested to be divided into following rooms by walls with connecting doors:
    i. One room of about 15 sqm for the Consultants.
    ii. Two rooms for the PIT (15 and 10 sqm)
    iii. One room of about 20 sqm for office room cum supporting staffs' room.
    iv. A meeting/conference room of about 25 sqm.
    v. One kitchenette/pantry of approximately 10 sqm with standard facilities (gas stove, microwave oven, refrigerator, tea/coffee maker, electric kettle, etc.)
    vi. There shall be at least two standard facility toilets with shower (about2.75 sqm each) in total in the office.
    vii. Rest space, if any, shall be used for foyer/veranda/lobby/corridor/utility room etc.
c) This office shall be well protected against weather, dust, mosquitoes and other insects, noise and other nuisance to the satisfaction of the Engineer-in-Charge/Consultant /PIT.
d) The office shall be constructed/established at site.
e) All office rooms and the meeting room shall be air-conditioned.
f) Whole office shall be covered by minimum 10 mbps broadband WiFi internet service.
g) The Bidder shall provide a) four office tables, b) two secretariat tables, c) four steel cabinets, a 17-seater conference table with revolving chairs, 20 nos. non-revolving office chairs, 7 nos. high-back revolving office chairs, all of a design, standard and finish approved by the Engineer-in-Charge. Crockeries, tea sets,

glass sets enough to serve 30 persons, door and window curtain shall have to be provided. All these items shall be purchased new by the Bidder.

h) The bidder shall provide one refrigerator (min. 200-liter capacity) and one microwave oven (min. 20-liter capacity) and Drinking Water dispenser with regular supply of drinking water in 20-liter PET bottles. The pantry shall be equipped with a pair of stove/burner. There shall be one first-aid box and sanitizer spray in the office with regular supply of all consumables. All these items shall be bought new.

i) The conference room shall be equipped with a 75-inch LED LCD TV (Brand Samsung/Sony/LG) new color multimedia all complete with easy wired/cable (VGA and HDMI) as well as wireless connectivity to laptops for convenience of conducting any meeting.

j) Necessary cleaning, washing, dusting of rooms and toilets shall be done on daily basis by the Bidder by engaging hired personnel.

k) The Bidder shall provide electricity, water, gas, lighting and ceiling fans to the satisfaction of the Engineer-in-Charge and the toilets shall be with tiles fitted on floors and walls, wash basin, shower, one high commode and one pan. The required number of electric bulbs, ceiling fans, calling bells and electric power points etc, shall be provided.

l) The Bidder shall provide 06 (six) new smart phone mobile telephone sets for PIT/ Field Engineers' use and pay bills up to a maximum of Tk.1000/- (average) per month for each set. The brand and model of the smart phones shall be the latest any of the renowned brand (Samsung/Xiaomi, etc.) of moderate price range (approximately BDT.50,000/-). Also provided 06 in nos. walkie-talkie sets (with spare batteries and adequate nos. of chargers) of commercial frequency (with license if required) for smooth works.

m) The bidder shall provide 05 (five) sets of new desktop computer (Configuration: Intel Core i7 13th Gen. processor [16 cores, 24 threads, 30 MB Intel® Smart Cache],Liquid CPU Cooler, 64 GB DDR5 RAM, 1.0TB SSD M.2 NVMe PCIe Gen5 Hard Drive, 24-inch LED LCD IPS color monitor, motherboard, keyboard, mouse, casing with power supply unit and cooling fan, 1000VA UPS, Wi Fi internet connectivity with external antenna, wired LAN connectivity, webcam with 720p video resolution, wired over-the-ear headphone with

microphone,128GB USB pen drive, CD/DVD writer, etc. all complete including computer table and chair etc.)

n) The bidder shall also provide 02 (two) sets of brand-new laptop computer one for the consultant's engineers and one for the PIT (Configuration: Intel Core i7 13th Gen. processor [12-core, 16-thread, 30 MB Intel® Smart Cache], 32 GB DDR5 RAM, 1.0 TB SSD M.2 NVMe PCIe Hard Disk, 14-inch+ LED LCD color monitor with min. FHD 1920x1080p resolution, WiFi internet connectivity, backlit keyboard, built-in webcam, sound system with built-in speakers, Li-ion battery with charger, wired over-the-ear headphone with microphone,128GB USB pen drive etc. all complete). Suggested brands: Dell, HP, ASUS, Lenovo.

o) The bidder shall supply 01 (one) new multifunction photocopier device: Color laser photocopier + scanner + printer, (for maximum A3 size automatic double-sided copying with RADF, A3 size automatic duplex printing, A3 size automatic double-sided scanning with RADF unit), capacity at least 20 copies/min. copying and printing, built-in 100 GB storage, LAN networking, Wi-fi networking, total 2 nos. 500 sheet paper trays and regular supply of toner set, developer, paper, etc. as required throughout the project period. In addition to this, 2(two) nos. laser printers (monochrome, A4, auto both side printing capacity), and 2 (two) A4 size scanners for office use.

p) The bidder shall pay all the house rent, utility bills (electricity, gas, water, internet, cable TV) and bear all other maintenance expenses, if applicable.

q) The bidder shall employ, at his own cost, one full time peon-cum-cook and one full time house servant for the engineer's office for the convenience of the Engineer and other office staff.

r) The bidder shall provide safety shoes, helmets, safety gloves, safety eye-glasses, reflective safety jackets etc. For the all engineer and his staff for the whole project period as and when necessary. At least 10 (ten) additional sets of these shall be kept in the office for use by visitors.

Basis of Payment

The bidder shall quote the price in the tender schedule item keeping in mind the site office expenses in their Tender accordingly.

After completion of the project the above site office including furniture and office equipment (including computers, printers, scanners, photo copiers etc.), except the smart

phones, shall be the property of the Bidder and he shall have to remove these from site at his own expenses.

1.4 MATERIAL TESTING LABORATORY

The Bidder shall provide, construct, furnish, equip and maintain a material testing laboratory facility for the Engineer /PIT and his staff as described herein. The Bidder shall provide, install and maintain the furniture and equipment necessary for the laboratory facilities. The Bidder shall provide necessary electric and water connection for the laboratory.

The Bidder shall arrange the testing facilities for concrete and soil in a manner convenient for use and approved by the Engineer /PIT. Laboratory shall provide all equipment and gadgets necessary for testing concrete specimens, field monitoring of settlement records and other conditions as specified by Engineer /PIT.

The laboratory shall be provided with 240 volt, 50Hz electricity and enough outlets shall be provided to accommodate the required testing equipment; with lighting meeting the approval of the Engineer /PIT; with air conditioners and heating system sufficient to maintain a constant temperature of 20°C all the year round; adequate water storage and pressure for normal testing; minimum of 2 sinks with taps to accommodate wash gradations; standby generator to maintain power for lighting and test equipment for use when the primary electricity supply is not available ; rigid flooring adequate to support operating test equipment without vibration, dust proof covers for all balances; wall thermometer etc. A minimum of 3.5m of workbenches, 0.9m high by 0.8m, wide shall be provided and arranged in an acceptable manner. These work benches shall have tops covered with an approved plastic laminate or tin sheet, shall contain adjustable shelves and drawers and shall be constructed of 19mm plywood. The laboratory shall have a minimum of one exhaust fan and two opening windows with blinds and insect screens.

The Bidder shall obtain written approval, from Engineer /PIT for his proposed construction and arrangement of the laboratory.

The Bidder shall submit a list of the proposed laboratory equipment and accessories for the Engineer /PIT‘s approval prior to placing his order for this equipment. All equipment to be supplied to the laboratory shall be new, of highest quality and in perfect working condition. Any equipment damaged during shipment and/ or hauling and installation to the laboratory shall be replaced by the Bidder at his own expense.

The Bidder shall bear all costs pertaining to obtaining specimens of materials, mixes etc. including samples cut from paving courses after compaction, and the provision of necessary equipment and plant for obtaining these specimens, mixes and samples and transporting them to the Engineer /PIT‘s material testing laboratory or other locations as designated by the Engineer /PIT.

The Bidder shall complete the Material Testing Laboratory Facility to the satisfaction of the Engineer /PIT within 60 days of the date of commencement of work on site. Prior to acceptance of the Laboratory building and of the equipment, the Engineer /PIT shall inspect the said building and equipment for compliance with these Specifications.

The Bidder shall order all the required equipment and accessories for the Material Testing Laboratory within 30 days of signing the contract and shall provide documentary evidence of having placed the necessary orders.

The equipment installed at the Material Testing Laboratory shall be calibrated from time to time as directed by the Engineer /PIT. If the calibration and tests cannot be performed at the Material Testing Laboratory, they shall be performed at a laboratory approved by the Bidder. The Engineer /PIT shall select one laboratory technician and two laboratory attendants. The Bidder shall appoint and pay the salary of laboratory technician and attendants.

If the bidder fails to complete the laboratory facility within the specified period, the Engineer /PIT reserves the right to carry out any sampling and laboratory testing in any other laboratory designated by the Engineer /PIT with any fees and charges to be deducted from any amounts due to the bidder.

1.4.1 List of Laboratory Equipment and Accessories

The following laboratory equipment and shall be supplied by the Bidder at his own cost which will be property of the Bidder at the end of the Contract.

a) Twelve nos. cylinder casting sets (100mm diameter and 200mm height mould including base plate, tamping rod, straight edge etc.)
b) Two nos. slump measuring sets (cone including base plate, tamping rod etc.)
c) Five vibrators.
d) 1500mm x 1200mm x 900mm water bath for curing of concrete cylinders
e) Cylinder capping material (sulphur, grease etc.) and capping device
f) Vernier scale

g) Steel rule
h) Tray, bowls, cans
i) Spatula, scoop
j) Tamping rod
k) Measuring jars and funnels
l) Mug, water bucket
m) Water facility (tape, pipe etc.)
n) Gloves (12 sets)
o) Brush
p) Thermometer
q) Stop watch
r) Concrete Cylinder Compression Testing Machine, 2000 kN Capacity.

In addition, other tools, equipment, apparatus and devices as necessary shall be supplied.

1.5 GENERAL AND SUNDRY OBLIGATIONS

1.5.1 Surveys and Setting Out

Before commencing any part of the works the Bidder shall, together with the Engineer /PIT/Consultant, prepare a survey and take levels of the site of the Works, and shall agree with all records of the survey and particulars upon which any measurements of the works will be based. Failing such survey or agreement of records being prepared and signed jointly, the records of a survey by the Engineer /PIT shall be final and binding upon the Bidder. The Bidder shall carry out such other surveys as specified in Particular Specification and necessary for planning his works.

A project benchmark and survey reference point shall be established on the site by the Bidder in the form of a concrete monument, which shall contain a recessed brass plate protected by a lockable steel cover. In addition to the Bidder's responsibilities under the conditions of contract, and within 4 weeks of the date for commencement, the Bidder shall provide such control stations, which are necessary or desirable for setting out the works. All control stations shall be of a construction and in a position to which the Engineer /PIT has given his consent and which subsequently have the coordinates agreed with the Engineer /PIT.

The Bidder shall give the Engineer /PIT not less than 24 hours notice in writing of his intention to set out or give levels for any part of the Works so that arrangements can be

made for checking the work. Work shall be suspended for such time as is necessary for checking lines and levels on any part of the Works. The Bidder shall at his own expense provide all assistance, which the Engineer /PIT may require, for checking the setting out. The necessary survey instruments shall be supplied by the Bidder at his own cost which will be property of the Bidder at the end of the Contract.

1.5.2 Sign Boards

The Bidder shall supply, erect, maintain and remove on completion notice boards at each public entrance to the Site, giving brief details of the project in English and Bengali, including but not limited to, the names of the Bidder's Employer and Consultant. The wording, colors and style of the signs and size of lettering and the like shall be to the approved of the Engineer /PIT.

1.5.3 Progress Photographs

Providing minimum ten (10) copies colored post-card size progress photograph of 'Works under contract' taken by professional photographer which record the progress of the Works.

1.6 PROGRAMME AND PROGRESS REPORTS AND RETURN

1.6.1 Program

The program required shall be presented in the form of a bar chart and time/ location chart (Gantt chart) covering all the main items of work, showing their interrelation with and interdependence on other items of work, and be laid out in a format which will permit tracking of progress of the various items to be indicated on it throughout the execution of the work. It shall be supported by a critical path network (CPM) in a form capable of being updated, showing all requisite operations, earliest and latest start and finish dates, duration, float and critical activities, and shall be submitted with the program. Microsoft Project or any other equivalent software may be applied in project scheduling and planning.

The program shall show the delivery periods and dates of arrival on site of all major plant and materials showing the relationship with the works.

The method statement required shall include a list of major items of plant and equipment and personnel to be used including standby equipment, methods of execution of major item of works, temporary works and other like matters. The program shall be submitted in three copies to the Engineer /PIT within 4 weeks from the date of Acceptance of the Tender.

1.6.2 Progress Meetings

Regular meeting will be held at weekly intervals between the Engineer /PIT and the Bidder to discuss the program of work in each work period and progress of the Works and any problems, which may have arisen. The Bidder shall give to the Engineer /PIT at these meetings details of his progress to-date in relation to the program.

1.6.3 Weekly Return

At weekly in intervals the Bidder shall supply to the Engineer /PIT, rectum of labor and Constructional Plant and in addition, a schedule of the main work items in each section of the works showing quantitative progress during the previous week and cumulative progress to date. On the last day of each week the Bidder shall issue the Engineer /PIT with details of his intended program of work for the following week.

1.6.4 Monthly Returns

At monthly intervals and not later than the first week in every month, the Bidder shall submit to the Engineer /PIT a progress report for the previous month, which shall include, but not be limited to the following:

a) Program marked up with any agreed amendments and showing the actual percentage completion of each of the main items of work, in such a way that comparison can be made with the schedule percentage completion of each item.

b) Weather and other conditions, including daily temperature range, humidity, rainfall, wind speed and direction, etc.

c) Summary of staff and labor employed on the Site

d) Schedule of Constructional Plant on Site with dates of arrival and departure as appropriate.

e) Schedule of principal material items with dates of placing orders, progress of manufacture, dates of delivery to Site etc. and

f) Record of Site safety.

1.6.5 Submission of Returns

All reports, statements, resumes, diagrams or drawings etc. that the Bidder is required to submit to the Engineer /PIT during the progress of the works shall be furnished in quadruplicate unless otherwise directed.

1.7 QUALITY ASSURANCE, STANDARDS AND MATERIALS TEST

1.7.1 Procedures

The Bidder shall not commence any item of permanent work until he has submitted to the Engineer /PIT a written statement of his proposed procedure for his own inspection of that item, recording such inspection and obtaining the Engineer's written approval thereof. Every such statement shall identify the individuals on the Bidder's staff who are responsible for inspecting the workmanship and/ or testing the materials for the item in question, the place of inspection, the stages at which inspections and tests are to be made and the detailed aspects to be verified or measured in each inspection. Each inspection shall be recorded.

1.7.2 Inspection Records

The record shall identify the inspector, the place, the date and time when the inspection was completed, the section of the works inspected or part of the materials, and its state of completion. Reference shall be made to the relevant detailed working drawings and the specific aspects or properties, which were checked or measured. The records of inspections and tests shall be stored in an ordinary fashion on the site by the Bidder until the issue of the Certificate of Maintenance for the whole of the works, or such earlier time as the Engineer /PIT may instruct, and the Engineer /PIT shall have the right of access to them at all times.

After the issuance of the Certificate of Maintenance for the whole of the Works, or such earlier time as the Engineer /PIT may instruct, the Bidder shall, as instructed by the Engineer, either dispose of the records or deliver them as directed.

1.7.3 Bidder's Inspection

The Bidder shall be responsible for inspecting all materials and workmanship. No work shall be covered up without the written approval of the Engineer. All items of work concealed in the finished work shall be inspected by the Bidder immediately before they are covered up. Inspection and testing shall be recorded according to the procedure

1.7.4 Engineer's Inspection

In addition to the Bidder's inspection, the Bidder shall afford and facilitate access at all times for the Engineer's inspection and testing of materials and workmanship. The Bidder shall provide means of access and assistance as may reasonably be required by the Engineer. For all times of work the Bidder shall give adequate notice in writing to the Engineer /PIT so that the item in question is complete and is ready for inspection, and shall not cover it by

subsequent work until the Engineer /PIT shall have confirmed in writing that it has been inspected and is approved.

1.7.5 Notices of Works Off Site

The Bidder shall give adequate written notice to the Engineer /PIT of the preparation or manufacture at a place not on the site or any pre-constructed units or parts of units or materials to be used in the works. Such notice shall state the place and time of the preparation or manufacture and be given sufficiently in advance as to enable the Engineer /PIT to make, and not only when the units or parts are completed. Works off site shall not commence without the prior approval of the Engineer.

Any units or parts which are prepared or manufactured without such prior notice having been given to the Engineer /PIT may be rejected if the Engineer /PIT considers that his inspection was necessary during the progress of the preparation of manufacture.

1.7.6 Standards

Except where otherwise specified or authorized by the Engineer /PIT all materials shall conform to the latest edition of the relevant specification, mentioned in particular Specification, current at the date of invitation of Tender.

Where reference is made to the Standards in imperial units, the nearest unit of imperial dimension to the metric dimension quoted in the drawing or specification shall apply.

Materials meeting other authorized standards, which ensure an equal or higher quality than the standards specified, will be accepted at the discretion of the Engineer. Any such alternative standard processed by the Bidder shall be submitted in the English language, for approved by the Engineer.

1.7.7 Proprietary Product

A proprietary or brand name or the name of a supplier or manufacturer may be indicated on the drawings or in the specification in respect of some items. Alternative items based on recognized national standards of the country of origin will be accepted provided that documented proof in English language is submitted to the Engineer /PIT for his approval sufficiently in advance and showing that the alternative proposed is of equal or higher quality and performance than the specified item.

1.7.8 Materials to be New

All materials to be used in the Permanent works shall be new unless otherwise specified or agreed by the Engineer /PIT in writing.

No materials to be incorporated in the permanent works shall have previously been used in the temporary works unless otherwise specified or agreed by the Engineer /PIT in writing.

1.7.9 Orders for Materials

Before orders are placed for any materials of any description to be used in the permanent works, the Bidder shall submit to the Engineer /PIT the names and address of the manufacturers or suppliers proposed. Following approval by the Engineer, the Bidder shall submit to them, copies of all orders placed for such materials.

1.7.10 Samples

In accordance with the relevant provisions of this specification, the Bidder shall, as directed by the Engineer/PIT, supply samples of materials to be incorporated in the works. The samples required for approval shall be submitted by the Bidder in labeled boxes suitable for storage, and in sufficient time for testing, due allowance being made for the fact that if samples are rejected, further samples will be required. Approved samples will be kept by the Engineer/PIT, who will reject any materials not corresponding in character and quality with the approved samples.

1.7.11 Certificates

All manufacturer's certificates of test, proof sheets, mill sheets, etc. showing that the materials have been tested in accordance with the requirements of the relevant approved standard or this specification, shall be supplied in English language by the Bidder to the Engineer /PIT free of charge.

1.7.12 Nuisance Caused by Windblown Sand and Dust

The Bidder shall take such precaution and measures as are necessary to restrict to an acceptable reasonable minimum, of which the Engineer /PIT shall be judged, sand and dust being blown from the surfaces of the work areas so as to cause a nuisance to any other persons or property.

1.8 OBTAINING PERMISSIONS FROM GOVT. AGENCIES

The bidder shall take necessary steps to obtain permission/approval of all relevant govt. agencies eg. Environmental Dept., Fire Service and Civil Defense, Civil Aviation, City Corporation, Power Development Board, BTCL, Titas Gas Transmission and Distribution Co. Ltd. and others as applicable.

CHAPTER 2 CLEARING OF SITE

2.1 INTRODUCTION

The work to be performed under this Section includes any required demolition, clearing and grubbing, and stripping of topsoil as hereinafter specified, within site limits, including the right of way for the boundary walls and access roads when applicable, as shown on the drawings.

2.2 CLEARING AND GRUBBING

a) Clearing and Grubbing includes the removal of trees do marked, all brush, roots, hedges, bamboo clusters, fences, rubbish, and all other objectionable material all such materials shall be disposed of by the bidder subject to approval of the PIT. All trees, plants, or structures designated by the Engineer, to remain, shall be carefully protected by the Bidder during the entire period of the work.

b) All waste materials, debris, organic matters, filths including diversion of running water or drain if necessary or any other obstructions that may hinder in the way of construction work shall be removed from the site, and disposed of to the satisfaction of the Engineer/PIT.

2.3 STRIPPING

a) Within the area defined by each new building, roadway, parking area, and any other areas designated by the Engineer /PIT /Consultant, topsoil shall be stripped to depth of not less than 150mm below existing elevations. Unless otherwise directed by the Engineer, stripped topsoil shall be removed from the site.

b) Where shown on the drawings or as directed by the Engineer, all materials approved for reuse shall be separated and stockpiled or used directly in the work if in suitable condition. Permission for the possible reuse of any such material shall be at the sole discretion of the Engineer.

2.4 DISPOSAL OF WASTE MATERIAL

All debris and excess earth materials, as designated by the Engineer, shall be the property of the Employer and shall be deposited at a safe distance as shown by the Engineer.

2.5 METHOD OF MEASUREMENT

Since the contract will be an EPC and fixed price contract, no additional payment shall be made under this work.

CHAPTER 3 EARTH WORKS

3.1 SCOPE OF WORK

a) The work includes, but is not necessarily limited to, the furnishing of all materials and equipment and performing all operations necessary for and properly incidental to accomplishing all excavating, removal of surplus materials away from site, compacting, backfilling, and grading work, and trenching and backfilling for utilities as necessary to complete the project as shown and noted on the drawings and specified herein.

b) Any sub-soil investigations conducted by the Engineer /PIT will be made available for the Bidder's review. The Engineer /PIT assumes no responsibility regarding the correctness of these data and makes them available solely for information. It is the responsibility of the Bidder to verify all Sub-surface conditions prior to submitting Tender.

3.2 APPLICABLE STANDARDS

Pertinent provisions of the following listed current reference standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this specification to the extent required.

American Society for Testing and Materials (ASTM)

D1556 Test for Density of Soil in Place by the Sand-Cone Method.

D1557 Test for Moisture-Density Relations of Soils, using 10-pound Rammer and 450mm Drop,

3.3 SPECIFICATIONS

Fill: All soil or granular materials (F.M.>0.6) placed to raise the natural grade of the site or to backfill excavation.

On-site Material: Soil or granular material which is obtained from the required excavation on the site bounded by the property limits.

Imported Material: Soil or granular material which is hauled in from off-site areas.

Select Material: On-Site and/ or imported material which is approved by the Engineer /PITfor use as mechanical fill.

Compacted Fill: Fill upon which the Engineer /PIThas made sufficient observations and tests to determine and confirm that the fill has been placed and compacted in accordance with the specification requirements.

Degree of Compaction: the ratio, expressed as a percentage, of the dry density of the fill material as compacted in the field to the maximum dry density of the same material as determined by ASTM Test Designation D1557 above.

3.4 INSPECTION AND TESTING

a) All site preparation, cutting and shaping, excavating, filling, and backfilling shall be carried out under the inspection and control of the Engineer, who will perform appropriate field and laboratory tests to evaluate the suitability of fill material, the proper moisture content for compaction, and the degree of compaction achieved. Any fill that does not meet the specification, requirements shall be removed and/or re-compacted until the requirements are satisfied.
b) Cutting and shaping, excavating, conditioning, filling and compacting procedures require approval of the Engineer /PITas they are successfully performed. Any work found unsatisfactory or any work disturbed by subsequent operations before approval is granted shall be corrected in an approved manner as directed by the Engineer.
c) Tests for compaction will be made in accordance with test procedures outlined in ASTM D1557(C), as applicable. Field testing of soils or compacted fill in place shall conform with the applicable requirements of ASTM D 1 556.

3.5 WEATHER CONDITIONS

a) Fill material shall not be placed, spread or rolled during un-favorable weather conditions. When the work is interrupted by rain, fill operations shall not be resumed until field test by the Consultant indicates that the moisture content and density of the fill area as specified in these specifications or are in condition suitable enough, in the opinion of the Engineer, for resuming the work.
b) The control of water throughout the duration of this Contract shall be the sole responsibility of the Bidder, Control Methods shall be subject to the approval of the

Engineer /PITincluding the Bidder's equipment, plans, methods and installation procedures, etc,

3.6 SOIL MATERIALS

3.6.1 Select Material

a) All material to be used for mechanical fill and backfill shall be an inert, non-expansive soil (less than 50 percent passing a No. 100 Standard sieve), free from organic matter and other deleterious substances, and of such quality that it will compact thoroughly without the presence of excessive voids when watered and rolled/compacted. Fill material shall not contain rocks or lumps over 100mm in greatest dimension. All fill material to be used under the building, slabs, pavement, and structures and backfill shall be on-site and/or imported material, conforming to the above, with a liquid limit less than 30 and a plasticity index less than 15. Excavated on-site material will be considered suitable for compacted fill if it is free from organic matter and other deleterious substances and conforms to the requirements specified above.

b) The Engineer /PIT shall be notified at least one week prior to the start of filling and backfilling operations so that he may select for approval samples of the material intended to be used for filling and backfilling. No material shall be placed without the approval of the Engineer/PIT.

3.6.2 On-Site Material

Excavated earth material which is suitable for compacted fill or back fill, as determined by the Engineer, shall be conditioned for reuse and properly stockpiled as directed for later filling and back-filling operations. Conditioned material shall be free of debris and rubble. All rocks and aggregate, exceeding 100mm in the largest dimension, and deleterious materials shall be removed and disposed off in a manner as specified herein the specifications.

3.6.3 Imported Material

a) Where conditions require the fill material to be imported the material shall be a granular soil totally free of organic matter and shall meet or exceed the minimum requirements specified above have to be selected. ln addition, imported material may consist of pit run sand or sand-gravel mixture with a maximum size of

75mm and with not more than 5 percent passing a No. 200 U.S. Standard sieve (wet sieve).

b) Sand for compacted sand fill under concrete footings, foundations, slabs, and/or brick soling, or for aggregate drainage fill, shall be a clean and graded, all passing a No. 4 U.S. Standard sieve, and conforming generally to ASTM C33 for fine aggregate, with fineness modulus not be less than 1.00 or as determined by the Engineer.

3.7 STAKES AND GRADES

a) Bidder shall lay out his work, establish all necessary marks, bench marks, grading stakes, and other stakes as required, all as specified herein the specifications

b) Finished elevation for work to be constructed under this contract are indicated on the drawings, and, unless an inconsistency therein is brought to the attention of the Engineer /PITin writing prior to commencement of construction, the Bidder will be held responsible for the proper location and elevation of all work

3.8 EXCAVATION

a) Excavation for foundations, pits, trenches, footings, floor slabs, concrete walks, roadway pavements, parking areas and aprons, and any other structures indicated as well as common excavation for grading purposes, shall be to the lines and levels required. The bottoms of all trenches shall be to grade, tamped firm, clean and free from all debris or foreign matter.

c) Excavations shall be kept free from water at all times. Adequate equipment shall be maintained at the site for this purpose.

d) If material below and beyond the required dimensions has been removed or disturbed due to unauthorized over excavation or for any other reason, the space shall be placed, filled and compacted with select material, as directed by the Engineer /PIT, with no additional cost to the Owner.

e) Excavated earth material which is suitable for compacted fill or backfill, as determined by the Engineer, shall be conditioned for re-use and properly stockpiled for later use as hereinbefore specified under "Soil Materials".

f) Abandoned sewers, piping, and other utilities encountered in the progress of excavating, shall be removed and the ends plugged with concrete or in any other manner which is acceptable to the Engineer.

g) Active sewers, water and gas pipes, electric power, light or telephone poles, conduits, or wires, and any other active utility lines encountered, shall be immediately reported to the Engineer /PIT and authorities involved. The Employer and proper authorities shall be allowed free access to take that measures they may deem necessary to repair, relocate, or remove the obstruction as determined by the Engineer.

h) All debris and excess earth materials shall be removed from the site and disposed off as specified in chapter 3 of this Specification.

i) Open excavations, trenches, and the like shall be protected with fences, barricades, covers, and railings as required to maintain safe personnel and vehicular traffic passage. Freshly graded surfaces shall be protected from erosion until such time as permanent drainage and erosion control works have been installed.

3.9 TRENCHING AND BACKFILLING FOR UTILITIES

3.9.1 Trenching

a) Trenches shall be excavated to the lines, grades, and dimensions indicated on the drawings. Maximum allowable width of trench, measured at the top of the pipe, shall be the outside diameter of the pipe plus 450mm, to the outside of any trench bracing. Minimum width shall be according to the Manufacture/s recommendations for type of pipe being used. However, the minimum shall not be less than the outside diameter of the pipe plus 100mm.

b) Trenching shall include the removal of all material or obstruction of any nature, the installation and removal of all sheeting and bracing, and the control of water, as necessary to construct the works as shown. Unless otherwise indicated on the drawings, excavation for pipe lines shall be by open cut. Crossing pipelines shall be protected by using hand excavation or as directed by the Engineer.

c) Excess and undesirable materials shall be disposed off as specified in the Specification.

d) When the bedding material encountered is mud, or other unstable material, the bed shall be made firm and solid by removing stated unstable material and replacing same with sand, or other approved material, compacted to at least 90 percent.

e) Where water is encountered in the trench, free draining sand shall be used as required to drain the water and provide stable bedding.

f) Bell holes shall be accurately placed and shall not be larger than reasonably required to make the joint.

g) Jetting will not be permitted.

3.9.2 Backfilling

a) The pipe trench shall be backfilled as indicated on the drawings, All back fill material shall be compacted in 150mm lifts to at least 90 percent.

b) To prevent damage, the utmost care shall be exercised in placing the initial layers of backfill around and over the pipe. The work shall meet with the approval of the Engineer.

c) If required, to prevent the pipe from floating out of position, the water in the trench shall be sufficiently low, or the pipe shall be sufficiently weighted so that the net load on the pipe is downward.

d) Backfilling at catch basins, manholes, and similar structures shall conform to "Backfilling" hereinafter specified,

3.10 CUTTING, SUBGRADE PREPARATION AND COMPACTED FILL

3.10.1 Sub Grade Preparation

a) The area to receive the building including at least 600mm outside the exterior line, shall not be over-excavated below the bottoms of footings, foundations, and floor slabs as indicated on the drawings. Sub grade areas for ancillary buildings, roadways, parking areas, aprons and walks, and other structures shall not be over-excavated either.

b) Perform all cutting, blading, and shaping as required to cut and shape the sub-grade to the grades or elevations indicated on the drawings.

c) All underlying exposed sub-grade soil shall be compacted with suitable compaction equipment. All exposed scarified soils shall be compacted to detect possible localized zones of soft soils. Remove localized zones of soft soils and replace with compacted sand fill or mass concrete at Bidder expenses. Compaction shall be 90 percent. Compacting operations shall be performed under the observation of the Engineer/PIT. Successive compacting shall be performed as required to produce the required density, and a uniform surface smooth and true to grade.

d) Subgrade preparation work shall include control of water as required to protect finished compacted surfaces.

e) Surplus materials, if any, shall be removed and disposed off as per specification herein.

3.10.2 Compacted Fill

a) Sand: Sand for compacted sand fill or drainage fill shall be the clean and graded sand herein before specified under "Soil Materials".

b) Select Material: All material used for compacted fill shall be selected material as herein before specified under "Soil Materials". Clean and graded sand will also meet the requirements for select material. No material shall be placed without the approval of the Engineer.

c) Placing and Compacting

i) Sand and select material shall be spread uniformly in layers not to exceed 150mm in depth before compaction, Material which does not contain sufficient moisture to compact properly shall be sprinkled with water; if it contains excess moisture it shall be aerated or permitted to dry to the proper water content. Sand and select material shall be uniformly mixed with any added water before being compacted. Each layer of spread sand and select material shall be compacted to at least 90 percent except as specified in (b) below-

ii) The upper 300mm of sand fill under foundations, arid slabs shall be compacted to 95 percent. The upper 300mm of compacted fill under roadways, parking areas, aprons, and other brick paving where indicated shall also be compacted to 95 percent.

d) Control of Fill: Control of fill shall consist of field inspection and testing to determine that each layer has been compacted to the required density. Any layer or portion of layer that does not attain the compaction required shall be scarified and re-compacted until the required density is obtained.

e) Surplus Excavated Material: Surplus excavated material, if any, shall be removed from the site and disposed of as specified in this Specification,

3.11 COMMON FILL

a) Where pits, holes, low spots, or depressions are required to be filled or backfilled in order to bring the finish grade to the grades and elevations indicated on the drawings, and where structures are not involved, the fill material shall be suitable on site or imported material which contains no more than 10 percent by volume of organic material. Common fill requires approval of the Consultant before it may be used.

b) Common fill shall be spread uniformly in layers not to exceed 300mm before compaction. Compaction shall be 85 percent. lf required to be moistened or dried, follow the procedures hereinbefore specified for compacted fill.

3.12 BACK FILLING

a) Back filling shall not be placed against footings or building walls or other structures until approved by the Engineer/PIT.

b) Backfill material shall consist of select material as hereinbefore specified for compacted fit.

c) Backfill shall be placed in 150mm layers, levelled, rammed, and tamped in place. Jetting shall not be permitted; excessive puddling will not be permitted. Compaction of all layers shall be 95 percent.

3.13 FINISH GRADING

Finish grading in all areas shall be to elevations and grades indicated on the drawings.

3.14 METHOD OF MEASUREMENT

3.14.1 Excavation and Back Filling

All excavation shall be measured between the outside lines of the element in plan. Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any extra excavation or back filling which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

3.14.2 Filling, Common or Compacted

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 4 FORMWORK

4.1 SCOPE OF WORK

The work to be performed under this Section includes the furnishing and installing and removing of forms for all cast in-place concrete work as shown and noted on the drawings and as specified herein.

4.2 APPLICABLE STANDARDS

a) Pertinent provisions of the following listed current reference standard shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this specification to the extent required. At least one copy of current ACI 347 shall be kept available at the project's central office.

b) American Concrete institute (ACI) current issue of - ACI 347 Recommended practice for Concrete Formwork.

4.3 MATERIALS

4.3.1 Earth Forms

Earth forms may be used for footings and foundations only where the soil is firm and stable and the concrete will not be exposed, where earth forms are to be used, excavations shall be cut neatly and accurately to size for placing of concrete directly against the excavation.

4.3.2 Form Surface Materials - General

Form surface materials, regardless of type, shall permit tight construction to prevent seepage of concrete mortar or paste through joints, and shall be of uniform thickness to the extent that tolerances hereinafter specified will not be exceeded. Form surface materials shall be of sufficient thickness to withstand pressure of freshly placed concrete and of concrete vibrators without bow or deflection.

4.3.3 Form Surface Materials for 'As Cast' Concrete Surfaces

Form surface materials for exposed concrete surfaces shall be marine plywood, metal panel, or other panel type materials, acceptable to the Consultant and which will provide continuous, level, straight, smooth and exposed surfaces free from surface imperfections such as dent, bulges, misalignments, offsets form marks or impressions or stains etc.

4.3.4 Metal Panels

If used, shall be composed of flat smooth and non- staining steel sheet or plate of sufficient thickness and braced sufficiently, to prevent deflection from pressure of concrete. Steel forms shall be galvanized or coated to preclude imparting rust or other stains to concrete.

The bidder shall require to submit a complete design and shop drawing of the form work he intends to use in each stage of work, the design will include the method of supporting the formwork and shall indicate size, length etc. Of form ties, if used. The Consultant will review and approve such designs prior to erection of any formwork. The designs as approved will be basis upon which the bidder will proceed with his formwork. Design of formwork is the Bidders responsibility within the guideline specified herein.

Cement of single brand should be used - in order to get uniform colour of concrete proper mixing and constant w/c ratio should be maintained.

4.3.5 Form Surface Materials for Plastered Finish Concrete

Form surface materials for concrete surfaces which will later be plastered in the finished structure shall be plywood, metal, boards, or other acceptable material. Boards, if used, shall be nominal 30mm minimum thick material, sound and light commercial construction lumber, preferably ship-lapped or tongue-and-grooved and dressed. Minimum acceptable: boards which are dressed on at least one side and both edges for tight fit. Plywood or metal, if used, shall conform to the requirements specified above for exposed fair faced concrete.

4.3.6 Form Ties

Form ties shall be prefabricated rod, flat band, or wire type, or threaded internal disconnecting type, of sufficient tensile capacity to resist all imposed loads of freshly placed concrete and having external holding devices of adequate bearing area, Ties shall permit tightening and spreading of forms and shall leave no metal closer than 25mm from surface. Ties shall fit tight to prevent mortar leakage at holes in forms. Removable ties shall be coated with non-staining bond breaker. All ties shall be protected from rusting at all times. No wire ties or wood spreaders will be permitted, cutting ties back from concrete face will not be permitted.

4.3.7 Form Coating

Non-grain raising and non-staining Concrete release type that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent application of paint or other material applied to concrete surface, Coatings containing mineral oils or other non-drying ingredients will not be permitted.

4.3.8 Shores and False Work

Standard patented manufactured shores, or sound commercial construction lumber, subject to approval of the Engineer. Wood posts shall be a minimum of nominal 100mm Section. Bases for wood posts shall be precast concrete, nominal 175mm by 175mm by 150mm in height, minimum size, Shores and False work shall be the responsibility of the Bidder and shall support all imposed loads without deflection.

4.4 DESIGN OF FORMWORK

a) The Bidder will be required to submit a complete design and shop drawing of the formwork he intends to use in each stage of his work, the design will include the method of supporting the formwork and shall indicate size, length etc, of form ties if used, the Consultant will review and approve such designs prior to the erection of any formwork. The designs as approved will be the basis upon which the bidder will proceed with his formwork. Design of formwork is the Bidder's responsibility within the guidelines specified herein. Form ties shall be placed/arranged in a uniform geometric manner consistent with the general Architectural design of the building.

b) Design formwork so that it will safely support vertical and lateral loads which might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction which has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.

c) Design Forms and False work to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

d) Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof, provide trussed supports when adequate foundations for shores and struts cannot be secured.

e) Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit I forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressure of fresh concrete and construction loads for long span members without intermediate supports.

f) Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

g) All formwork and propping material shall be steel e.g. steel sheets, angles, MS pipes etc. Wood plank, bamboo etc. are not allowed.

4.5 LAYOUT OF FORMWORK

Bidder shall locate and stake out all lines and levels and elevations and be responsible for their accuracy.

4.6 CO-ORDINATION FOR EMBEDDED ITEMS

Obtain all necessary information and instructions included in other Sections as required to co-ordinate the installation of embedded and/or cast-in items and related work. Schedule the installation of items furnished under other Sections to be embedded or cast in concrete. Take all necessary precautions to maintain alignment and prevent damage or distortion of embedded and cast-in items during placement of concrete.

4.7 CONSTRUCTION OF FORMS

4.7.1 Earth Forms

Trench earth forms accurately and neatly to footing widths shown on drawings' Construct minimum 50mm nominal wood edge strips at each side of trench at top to secure reinforcing and prevent trench from sloughing Form sides of footings where earth sloughs. Earth forms shall be cleaned of debris and loose material before depositing concrete.

4.7.2 Formwork – General

Forms shall be constructed to correct shape and dimension, mortar tight, and of sufficient strength, and so braced and tied together that the movement of men, equipment, materials' or placing and vibrating the concrete will not throw them out of line or position. Forms shall be strong enough to maintain their exact shape under all imposed loads. They shall be so constructed that they may be easily removed without damage to the concrete before concrete is placed in any form, the horizontal and vertical position of the form shall be carefully verified and all inaccuracies corrected. All wedging and bracing shall be completed in advance of placing of concrete'.

4.7.3 As Cast Concrete

Forms to provide "as cast" concrete surface shall consist of new GP sheets (min. 14 SWG) in steel frames. The sheets shall be arranged in approved uniform pattern. Joints between panels shall be arranged and provided as determined by the Engineer /PIT /Consultant. Suitable joints and sufficient branches shall be provided between sheet to maintain accurate alignment in the plane of sheets.

4.7.4 Framing and Bracing

Space studs and framing at 400mm on center maximum for horizontal boards, 300mm on center maximum for plywood or other approved panels, and 400mm on center horizontally for vertical boards. Framing, bracing, supporting members, and centering shall be of ample size and strength to safely carry, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms, Use extra studs, waters, and bracing as required to prevent any deflection in form surfaces Concrete out of line level, or plumb will be cause for rejection of the whole work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining or settlement.

4.7.5 Tolerances

All tolerances shall conform to the applicable requirements of current issue of ACI 347R-14 Section 5.3.

4.7.6 Chamfered Corners

Corners if shown in drawing shall be chamfered 50mm, unless shown otherwise on drawings. Provide 45-degree triangular moldings in forms for all chamfering required.

4.7.7 Form Ties

Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading/bulging of the forms. Ties shall be placed at least 25mm away from the finished surface of the concrete. The use of ties consisting of twisted wire loops will not be permitted. Inner rods shall be left in concrete when forms are stripped. All form ties shall be spaced equidistant and symmetrical and shall lineup both vertically and horizontally, at all openings in forms, a row of form ties shall be installed around the perimeters of such openings within 150mm of the edge of the opening.

4.7.8 Cleanouts and Access Panels

Provide removable cleanout Sections or access panels at the bottom all wall forms, and at other locations necessary to permit inspection and effective cleaning of loose dirt, debris, and waste material. All forms and surfaces to receive concrete shall be cleaned of all chips, sawdust, and other debris and shall be thoroughly blown out with compressed air jets before concrete is placed.

4.7.9 Arrangement

Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

4.7.10 Construction Joints

Construction joints shall be formed as specified in Chapter 5. Of this Specification Provide surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints. Just prior to subsequent pour, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no "overlapping" of concrete and shall, as closely as possible, present the same appearance as butted plywood joints.

4.7.11 Embedded Items

Provisions shall be made for pipes, sleeves, anchors, cast-in steel materials, and other features as shown in drawing no wood shall be embedded in concrete. Complete cooperation shall be extended to suppliers of embedded items in their installation. Secure information for embedded items from other trades as required. All embedded items shall be securely anchored in correct location and alignment prior to placing concrete.

4.7.12 Opening for Items Passing Through Concrete

Frame openings in concrete where indicated on Architectural, structural, plumbing, mechanical, or electrical drawings: Establish exact locations, sizes, and other conditions

required for openings and attachment of work specified under other Sections. Carefully coordinate all work of this nature so that there will be no unnecessary cutting and patching of concrete.

4.7.13 Screeds

Set screeds and establish levels for tops of concrete slabs and leveling for finish on slabs. Slope slabs to drain where required or as indicated on drawings. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete, and forms shall be thoroughly wetted. Reinforcement, inserts, and steel rails shall be secured in position. Free-standing water shall be removed.

4.7.14 Shores and False Work

Bidder shall be fully and solely responsible for the proper strength, safely, and adequacy of all shores, False work, supports, posts, footings, and bases used on an in connection with the work. False work and supports shall be adequate in size and strength to resist the load imposed upon them without deformation, deflection, or settlement. Wedges in pairs or jacks shall be used where required to bring forms, shoring, or False work for the structure to exact elevations and uniform bearing before placing concrete. Single wedges will not be permitted. Vertical and lateral loads shall be carried to ground by formwork system or by the completed structure after it has attained adequate strength. Construct forms to permit their removal without disturbing the original shoring.

4.7.15 Coating of Forms

Thoroughly clean forms and coat with specified form coating before each use or reuse. Apply form coating to all forms in accordance with the manufacturer's specifications. Apply form coatings before placing reinforcing steel. Do not permit excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Rust stained steel forms will not be permitted to be used.

4.8 NOTIFICATION AND INSPECTION

Prior to placing of any concrete, and after placement of reinforcing steel in the forms, notify the Consultant so that proper inspection may be made, Such notification shall be made sufficiently in advance not less than 24 hours of placing concrete to permit arrangements to be made for inspection.

4.9 DEFECTIVE WORK

Any movement or bulging of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and in addition, the concrete work so affected. Reconstruction of forms and new concrete will be furnished at no additional cost to the Employer.

4.10 REMOVAL OF FORMS AND SHORES

a) The supporting forms and shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed there on safely. In no case may any forms or shoring be removed until the time and sequence has been approved by the Consultant. Earlier removal than specified below may be approved, based on the weather and tests of job-cured cylinders. All formwork shall be removed without damage to the concrete.

b) The minimum time for forms and shoring to remain in place shall be as follows:

Beams and slabs spanning up to 6 m (20 ft)	:	21 days
Beams and slabs spanning above 6 m (20 ft)	:	28 days
Soffits of openings in walls	:	14 days
Columns, Walls and Beam sides	:	48 Hours
Slabs on grade and sides of footings	:	48 Hours

c) Any request for earlier removal of forms and shoring shall be made to the Consultant in writing.

d) During the period that forms are in place on the concrete work, said forms shall be kept wet at all times. Concrete shall be immediately wet down after removal of forms and kept wet for a total period of fourteen (28) days after concrete is placed.

e) Forms shall be left in place as long as possible to permit shrinkage away from concrete.

f) In removing plywood or panel forms, no metal pinch bars shall be used and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedging shall be done gradually and shall

be accompanied by light tapping on the panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.

g) Do not remove shores until supporting members have attained sufficient strength to carry the imposed loads.

h) After stripping, protect all concrete to be exposed in the finish work from damage, with boards and no staining building paper, or other suitable materials, to prevent staining of concrete, spelled edges, chips, or other damage.

i) Nothing herein shall be construed as relieving the Bidder of any responsibility for the safety of the structure,

4.11 REUSE OF FORMS

Do not reuse any form for fair face concrete work which cannot be reconditioned to “like new" condition. Discard forms considered unsatisfactory by the Engineer. Thoroughly clean forms, repair as necessary, and recoat forms with specified form coating before each reuse. Apply form coating in accordance with the manufacturer's specifications as herein before specified for new formwork.

4.12 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 5 PLAIN AND REINFORCED CONCRETE

5.1 SCOPE OF WORK

The work to be performed under this Section includes the manufacturing, transporting, placing, finishing and curing of all concrete as shown and noted on the drawings and as specified herein.

5.2 APPLICABLE STANDARDS

Pertinent provisions of the following listed reference standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this specification to the extent required.

ACI 301	Specifications for Structural Concrete for Buildings
ACI 211.1	Recommended Practices for Selecting Proportions for Normal Weight Concrete.
ACI 304	Recommended Practices for Measuring, Mixing, Transporting, and Placing Concrete.
ACI 305	Recommended Practices for Hot Weather Concreting
ACl 318	Building Code Requirements for Reinforced Concrete
ASTM C31	Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field.
ASTM C33	Specification for Concrete Aggregates.
ASTM C39	Test for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete,
ASTM C87	Test for Effect of Organic impurities in Fine Aggregate on Strength of Mortar.
ASTM C136	Test for Sieve or Screen Analysis of Fine and Coarse Aggregates'
ASTM C143	Test for Slump of Portland cement Concrete,
ASTM Cl50	Specification for Portland cement.

ASTM C172 Sampling Fresh Concrete.

ASTM C494 Specification for Chemical Admixtures for Concrete.

ASTM D-1751 Specification for Expansion Joint Fillers for Concrete Paving and Structural Construction (No extruding and Resilient Bituminous Types).

ASTM D1850 Specification for Concrete Joint Sealer, Cold Application Type.

Bangladesh National Building Code 2020.

Bangladesh Standards and Testing Institution (BSTI)

5.3 MATERIALS

5.3.1 Cement

Cement shall be as per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength class 42.5 N.In addition, the following matters shall be properly addressed.

a) The cement shall be stored in such manner as to permit easy access for proper inspection and handling. One brand of cement shall be used through out on the same work except by written permission from the Engineer, different types of cement shall be stored separately and shall not be mixed, the cement shall be protected from moisture and damage in transit and in storage, the floor of the store room shall be raised at least 300mm from ground by wooden platform, dunnage, or pallet and shall be maintained moisture free at all times. Deteriorated and hardened cement will not be permitted in the work, and will be rejected by the Consultant. Any cement rejected shall be promptly removed from the site.

b) The cement shall meet the chemical and physical requirements of BDS EN 197-1 applicable types. A supplies certificate attesting to the compliance of the cement to the BDS EN 197-1 requirements shall be furnished with each shipment and from each source of cement procured. No cement will be approved for use in the work without such certification. The Consultant may, at his option, arrange to sample and test cement delivered, in accordance with BDS EN Standards, for verification of quality. Cement failing to pass such tests will be rejected for use on the project.

c) Test will be done for. i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1 3 and 7 days), iii) Fineness by EN 196-6.

5.3.2 Concrete Aggregates for Structural Works

Concrete aggregates shall conform to "specifications for Concrete Aggregates" ASTM C-33, or to a standard acceptable to the Engineer /PIT producing concrete strengths and shall be in accordance with the relevant structural design drawings.

5.3.2.1 Fine Aggregates

a) General characteristics: Fine aggregate shall consist of natural sand conforming to these specifications.

b) Grading: Fine aggregate shall be graded within the following limits, using U.S Standard sieve sizes:

Sieve	Percentage Passing
20mm	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

The fine aggregate shall have not more than 45 percent retained between any two consecutive sieves as shown above and its fineness modulus shall be not less than 2.50.

c) Deleterious Substances: the amount of deleterious substances in fine aggregate shall not exceed the limits prescribed below

Item	Maximum, Percent by weight of total samples
Clay	3.0
Materials finer than No. 220 sieve	5.0
Coal and Lignite	1.0
Chloride content	Nil

d)Organic Impurities:

1. Fine aggregate shall be free of injurious amounts of organic impurities. Except as herein provided, aggregate subjected to the test for organic impurities and producing a colour darker than the standard shall be rejected.

2. A fine aggregate failing in the test may be used, provided that the discoloration is due principally to the presence of small quantities of coal, lignites, or similar discrete particles.

3. A fine aggregate failing in the test may be used, provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 day calculated in accordance with Method ASTM C87 is not less than 95 percent.

4. Fine aggregate shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of mortar or concrete.

e)Soundness: Fine aggregate subjected to five cycles of the soundness test, shall show a loss, weighted in accordance with the grading of a sample complying with the limitations set forth under the head "Grading" not greater than 10 percent when sodium sulfate is used or 15 percent when magnesium sulphate is used.

5.3.2.2 Coarse Aggregate

Coarse aggregate shall be as per conforming of the requirements of ASTM C-33 and shall be clean, hard, tough and grades in size free from vegetable or other organic matter. The size of coarse aggregate shall be one of the three sizes tabulated below but should be as large as possible while conforming to the condition that the largest size of aggregate shall not exceed 1/5 of the narrowest clearance between forms or 3/4 of the narrowest distance between parallel reinforcing bars.

a) Coarse aggregates shall be crushed natural stone chips with maximum size of 20mm except that for the RC wearing course, the maximum size shall be 12mm. All coarse aggregate must be well graded, i.e. shall have all particle sizes between 5mm and 20mm (or 12mm for RC wearing course) in appropriate proportion. If necessary, coarse aggregates of different maximum sizes may be blended/mixed to attain good grading. All coarse aggregates must be free from dust and particles of size less than 5mm. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification.
   TESTS: Sieve analysis, ASTM C136-14

b) Grading: Grading Requirements for Coarse Aggregates

Size No.	**Normal Size (Sieves with square opening)**	**Amounts finer than each laboratory sieve (Square opening) weight percent**							
		50mm	40mm	25mm	20mm	12mm	20mm	No.4	No.8
467	40mm to No. 4	100	95-100	-	35-70	-	10-30	0-5	-
57	25mm to No. 4	-	100	95-100	-	25-60	-	0-10	0-5
67	20mm to No. 4	-	-	100	90-100	-	20-55	0-10	0-5

The fine and coarse aggregates shall be washed at least once in clean water immediately before being used in concrete production.

c) Soundness: Coarse aggregate, subjected to five cycles of the soundness test, shall show a loss, weighted in accordance with the grading of a sample complying with designated limitations set forth under 'Grading" not greater than 12 percent when sodium sulphate is used or 18 percent when magnesium sulphate is used.

d) Limits for deleterious substances in coarse aggregate:

Item	Percent by weight
Clay lumps	0.25
Soft particles	5.0
No. 200 sieve	1.0
Coal and Lignites	0.5
Chloride contact	Nil

e) Abrasion: Coarse aggregate shall be tested following Los Angeles Abrasion Testing method (ASTM C131-14). Abrasion value shall not exceed 25% for coarse aggregate to be used in structural concreting works. Loss shall be determined on the test size or sizes or most nearly corresponding to the grading is to be used, the limit on abrasion loss shall apply to each.

f) The boulders to be used for coarse aggregates in concrete shall have the following property.

Compressive strength (minimum)	28 MPa
Specific gravity	2.4 - 2.6
Unit Weight	2240-2560kg/m^3.(140-160 lb/ft^3)
Porosity	2.1% max.
Water Absorption	1.5 - 6% (by wt.)
Minimum size	100mm

5.3.3 Admixtures

a) Bidder shall include, in the mix, approved concrete admixture to reduce porosity and permeability in concrete and at his option, may also include approved admixtures in the mix to improve the water cement ratio or workability of the concrete, providing the strengths specified and other desirable characteristics of

the concrete can be achieved and maintained. Chemical admixtures shall conform to the applicable requirements of ASTM C494.

b) Acceptable products shall be those approved by the consultant.

c) Any and all admixtures must be approved by the Engineer /PITand must be a part of the laboratory designed mix before they may be used in the Project.

d) Water: Water used in concrete shall be potable and free from objectionable quantities of silt, acid, alkali, salt, oil, salinity or any other impurities.

e) Curing Material: where it is required to cure or protect wall surfaces or other vertical surfaces after form removal, furnish appropriate waterproof sheet materials conforming to ASTM C171 or burlap conforming generally to ASHTO M182 Class 1. Where it is required to protect slab surfaces, use appropriate waterproof sheet materials conforming to ASTM C171.

f) Expansion Joint Filler: Resin bonded cork of sizes and thicknesses shown on drawings.

g) Expansion Joint Sealing Compound: Cold-applied poured latex rubber type sealant, conforming to ASTM D1850.

5.4 LABORATORY TESTS OF MATERIALS

5.4.1 General

Testing of cement and aggregates will be performed in a qualified testing laboratory. The laboratory will perform all tests requested and authorized by the Engineer/PIT. Tests and manufacture's certification of compliance with ASTM Specifications will be accepted in lieu of testing of cement, and analysis of aggregates. The Consultant may order independent verification tests, at his discretion. Tests and services will consist of the following.

a) Testing of cement in accordance with) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

b) Analysis of aggregates in accordance with ASTM C33, and sieve analysis of fine and coarse aggregates in accordance with ASTM C136.

5.4.2 Samples

Bidder shall furnish and deliver identified samples of all materials required for analysis and tests in the amounts required by the Testing Laboratory without charge. Deliver

samples of cement and aggregates to the Testing Laboratory at least 30 days prior to use on the job.

5.4.3 Strength of Concrete

Strength of concrete shall be the basis for acceptance. Concrete mixes shall be designed to achieve the required average compressive strength, f'_{cr}, at 28 days for the strength classes indicated on the drawings and specifications elsewhere in the tender document.

5.5 MIX DESIGN

a) Design of Concrete mixes, including recommended amounts of admixture (if any) and water to be used in the mixes, shall be determine by the Bidder by tests well before actual work.

b) Upon receipt of acceptable design mixes from the Testing Laboratory, Bidder shall submit these mix designs to the Crushed stone chips for review.

c) Bidder shall be responsible for incorporating into the structure concrete of the minimum strengths and slumps specified. On the basis of approved mix-design, no casting shall be allowed without a 'mix design' report'

5.6 MIXING

a) All concrete shall be machine mixed or plant mixed.

b) If mixer machine is used, mixing of ingredients shall be conducted in a mixture machine of approved type. Mixing shall be continued after all ingredients are in mixer for at least 1.5 minutes before any part of batch is released. Drum shall revolve at the rate of 15 to 20 revolutions per minute. Drum shall be completely emptied before any portion of succeeding batch is placed therein. Total volume of all materials used per batch shall not exceed catalogue-rated capacity of the mixer.

c) Water tank shall be so arranged that amount of water can be positively measured; while tank is discharged, inlet shall be automatically cut off.

5.7 PROPORTIONING

a) The proportions in which the various ingredients are to be used for different parts of the work shall be determined from time to 'time during the progress of work through proper mix design described earlier.

b) All materials shall be either measured by volume or weight, but either method must be approved by the Consultant. Cement content shall be the minimum amount necessary for strength, workability and plasticity. Amount of water shall be determined from mix design and properly controlled. Super plasticizer may be used to produce workability. The methods of measuring consistency of the concrete shall be controlled and checked by slump test at site.

c) The following slumps are suggested for the different concrete members:

	Minimum	Maximum
Pile cap and foundations	50mm	125mm
Columns, Beams, Lintels, Walls	50mm	125mm
Suspended Structural Slabs	50mm	150mm
Thin members	75mm	150mm
Precast Pile	100mm	200mm

The suggested slump of the concrete shall be as shown above. However, Consultant reserves the right to order a higher or lower slump to be used whenever, in his opinion, concrete of a particular structure is required to be deposited with a higher or lower slump. During the course of work, tests will be made by the bidder under the direction of the Consultant and the bidder shall render all the necessary assistance for carrying out these tests.

d) Volumetric measurements for aggregates, if required, shall be made on the basis of cubical steel containers/buckets of appropriate size. In no cases, semispherical pans shall be used in such measurements.

5.8 TESTING CONCRETE

5.8.1 Slump

This determination shall be made at the commandment concreting, on the occasion of each change in mix proportions, and thereafter as desired by the Consultant. The testing shall be in accordance with ASTM C-143 current issue.

5.8.2 Strength Tests

a) The Engineer /PITwill prepare and cure compression test samples. Three set of at least three cylinders will be made in accordance with ASTM C31. Size of test cylinders shall be 100mm dia. and 200mm height.

b) Strength tests of concrete will be performed either by the Consultant or in the testing laboratory of BUET or any approved Laboratory desired by the Engineer-in-charge /PIT.

c) Composite samples will be taken in accordance with ASTM C172. Each sample will be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

d) All cylinders in a set will be marked with a number on one end. The Consultant will record this number on his record of concrete placed, the cylinders will be cured at job site under field condition.

e) One set cylinder will be tested at 7 days and a second set at 28 days in accordance with ASTM C39 in the laboratory as directed by Engineers. Cylinder strength at 7 days test shall not be less than 60% of the design strength.

f) The third set cylinder shall be kept at the job site until the 28-day test report on the second cylinder in the same set has been received by the Consultant. If this report is satisfactory, discard the third cylinder. ln the event the second cylinder tests are below the required strength, the Laboratory will then test the third cylinder at the age selected by the Consultant.

g) In the event the compressive strength of the third set cylinder, when tested, is below the specified minimum, the Consultant may require test core of the hardened structure to be taken by the testing laboratory in accordance with ASTM C42. If such test indicates that the core specimen is below the required strength, the concrete in question shall be removed and replaced without cost to the Employer, Any other work damaged as a result of this concrete removal shall be replaced with new materials to the satisfaction of the Consultant at no additional cost to the Employer. The cost of coring will be deducted from the contract amount. Where core cylinders have been taken by the Testing Laboratory and the concrete proves to be satisfactory, the cutout Section shall be restored to the original condition in a manner satisfactory to the Consultant at no additional cost to the employer.

5.9 CONVEYING AND PLACING CONCRETE

5.9.1 Notification

The Consultant shall be notified at least 72 hours in advance of the placing of any concrete. In any case, concrete pours shall be performed in accordance with a pre-established schedule.

5.9.2 Earth Bearing Surfaces

Soil bottoms for footings and slabs shall be approved by the Consultant before placing concrete.

5.9.3 Forms

Before placing concrete, forms shall be thoroughly inspected. All chips, dirt, and debris shall be removed, all temporary bracing and cleats taken out, all openings for pipes, conduits, and sleeves, properly boxed, all forms properly secured in their correct position and made tight, all reinforcements, anchors, steel rails, and embedded items secured in their proper places. Concrete which may be on the forms or reinforcement, and which is set and dry, shall be cleaned off and the forms and steel washed off before proceeding, Remove free water and all foreign matter from forms and excavations. Unless otherwise directed, sand or sandy loam shall be moist but not saturated just prior to placing concrete.

5.9.4 Anchors and Embedded Items

Anchors, bolts, regulates, sleeves, inserts, steel rails, and any other items to be castor embedded in concrete shall be accurately secured in position before the concrete is placed.

5.9.5 Pumping, Handling and Depositing

a) Pumping: Concrete shall be placed by pumping Equipment for pumping shall be of such size and design as to ensure a continuous flow of concrete at the delivery end without separation of materials. The concrete mix shall be designed to the same requirements as hereinbefore specified, and may be richer in lubricating components in order to permit proper pumping.

b) Concreting, once started, shall be carried on as a continuous operation until the Section of approved size and shape is completed. All structural fresh concrete shall be conveyed to place of casting by means of pumping. Manual conveying [e.g. using semispherical pans is strictly prohibited.

c) Concrete shall be handled as rapidly as practicable from the mixer to the place of final deposit by methods which prevent the separation or loss of ingredients. lt shall be deposited, as nearly as practicable, in its final position to avoid re-handling or flowing.

d) Concrete shall not be dropped freely where reinforcing will cause segregation, nor shall it be dropped freely more than 1200.mm. Concrete shall be deposited to maintain a plastic surface approximately horizontal.

e) In placing walls or thin Divisions of heights greater than 3000mm, openings in the form, elephant trunk termites, or other approved devices, shall be used which will permit the concrete to be placed without segregation or accumulation of hardened concrete on the forms or on metal reinforcement above the level of the fresh concrete. Such devices shall be installed so the concrete will be dropped vertically.

f) Concrete which has partially hardened shall not be deposited in the work. The discharge of concrete shall be started less than 60 minutes after the introduction of mixing water. Placing of concrete shall be completed within 60 minutes of the first introduction of water into the mix.

5.9.6 Vibrating and Compacting

a) All concrete shall be thoroughly consolidated and compacted by vibrators during the operation of placing and depositing, and shall be thoroughly worked around reinforcement, embedded items, and into the corners of the forms, internal vibrations shall be used under experienced supervision, and shall be kept out of contact with reinforcement and wood forms. Vibrators shall not be used in manner that forces mortar between individual form members.

b) Vibrators shall be flexible electric type or approved compressed air type, adequately powered and capable of transmitting to the concrete not less than seven thousand (7,000) impulses per minute. Vibration shall be sufficiently intense to cause the aggregate to flow or settle readily into place without separation of the ingredients. A sufficient number of vibrators shall be employed so that complete compaction is secured throughout the entire volume of each layer of concrete. At least one (1) vibrator shall be kept in readiness as a spare for

emergency use. Vibrators shall be such that the concrete becomes uniformly plastic with their use.

c) Vibration shall be close to the forms but shall not be continued at one spot to the extent that large areas of grout are formed or the heavier aggregates are caused to settle, Care shall be taken not to disturb concrete which has its initial set. Vibrators shall not be lowered deeper than the layer placed.

d) Where conditions make compacting difficult, or where the reinforcement is congested, batches of mortar containing the same proportions of cement to sand as used in the concrete shall first be deposited in the forms, to a depth of at least 25mm.

e) The responsibility for providing fully filled out, smooth, clean, and properly aligned surfaces free from objectionable pockets and blemishes shall rest entirely with the Contactor.

5.10 CONSTRUCTION JOINTS

a) When construction joints are necessary, they shall be made and located as indicated on the drawings. If for any reason the Bidder feels a change is necessary, he shall devise a placing plan, showing all construction joints, and shall submit to the Consultant for approval. Joints not indicated on the drawings shall be made and located to impair least the strength of the structure, and their locations shall be approved by the Engineer/PIT.

b) Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned with water and air jet, after concrete has semi- set, to remove all laitance. In addition to the foregoing, vertical joints shall be thoroughly wetted, but not saturated, before the placing of new concrete.

c) Approved key shall be used at all joints, unless indicated otherwise. All joints not shown on the prior approval of the Engineer. Forms shall be tightened before placing of concrete is continued.

d) Control joints in slabs on grade shall be located to surround or enclose areas not to exceed 80 sqm, with a maximum one-way dimension of 10m.

e) Water stopper shall be used in construction joint of basement wall and water reservoir.

f) Use of so called "kicker" in column casting is not permitted. Vertical alignment of columns and walls shall be maintained using digital total-station.

5.11 PROTECTION AND CURING

a) Protect concrete from injurious action of the elements and defacement of any nature during construction operations.

b) Keep concrete in a thoroughly moist condition from the time it is placed until it has cured for at least 14 days but not less than as shown in Chapter 4.

c) All formwork, until removed, shall be kept continuously wet to prevent drying of the concrete. If any forms are removed before the end of ten days after placing of concrete, the exposed concrete shall be kept continuously wet for the remaining period by protecting the concrete with burlap kept continuously moist. Concrete shall not be allowed to dry during the curing period because of finishing operations.

d) Carefully protect exposed concrete corners from traffic or use which will damage them in any way.

e) Protect freshly placed and finished concrete slabs from damage from drying wind or rain by covering with appropriate waterproof sheet materials, as and when required. All cast surfaces shall be covered with polyethylene sheet.

5.12 CONCRETE FINISHING

Surface finish of concrete shall be according to type of finish in Architectural, structural drawings or in schedule of work.

a) As cast fair face' concrete surface shall receive no extra finishes and shall be level, smooth and free from surface imperfections such as honeycomb, dents, bulges, sand streaks, pits, air bubbles, misalignment, offset and must be uniform in texture and colour all through, as it is cast and shall be acceptable to the Consultant Design of form, proportioning of concrete mix and casting procedure for producing the ‘As cast fair face' concrete surface shall be the responsibility of the Bidder.

b) Making up of pits and air bubble etc. may be allowed to some extent only with the permission of the Engineer /PITand retouching of surfaces may also be allowed in case of no uniformity of colour at Bidders own cost.

c) Plaster finish concrete surface shall receive plaster finish later and shall be even, level and free from honeycomb, dents, bulges, sand streaks, other defects such as misalignment and offset. Patching of defective work (within limits) shall be allowed only on permission from the Engineer.

d) Sample panels large enough in two lifts of "As Cast Fair Face" concrete surface shall be built and shall be approved by Engineer /PITat least 30 days in advance before the actual work.

5.13 SLABS AND FLAT WORK

5.13.1 General

Exposed slabs and flatwork shall be placed and finished monolithically. Strike off and screed slabs to a true surface at required elevations and thoroughly compact concrete with floats or tampers to force coarse aggregate below the surface, Finish slab on same day that concrete is placed.

5.13.2 Steel Trowel Finish

a) Slabs and flatwork indicated on drawings to have steel trowel finish shall receive a monolithic steel trowel finish. Surface shall be screened, wood-floated and steel-toweled. Trowel shall be vigorously used at an angle under pressure by the finisher until toweling gives evidence of shine or gloss as required to make a smooth, hard, dense, impervious surface, free of defects. Finishers shall work from knee boards laid flat upon the surface. Mechanical or power-driven toweling machines may be used if the desired finish and level tolerances can be obtained by their use.

b) After placing concrete slabs and flatwork, do not work the surfaces further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power driven float, or hand floating. Consolidate the surface with power-driven floats, or by hand floating. Check and level the surface plane to a tolerance not exceeding 1:500 when tested with a 3m straightedge placed on the surface at not less than two different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth texture.

c) After floating, begins the first steel trowel finishing operation, using a power-driven trowel or hand trowel. Begin final toweling when the surface produces a ringing sound as the trowel is moved over the surface. Consolidate the concrete surface by the final hand- toweling operation, free from trowel marks, uniform in texture and appearance and with a surface plane tolerance not exceeding 30mm in 3m when checked with a 3m straightedge.

d) Basement floor slab and all exterior slabs and paving shall receive a broom finish.

5.13.3 Broom Finish

Exposed-concrete slabs and paving, where indicated on drawings, shall receive a monolithic broom finish, Broom finish shall be finished same as steel trowel finish, except that after hand toweling, concrete surfaces shall be finished by scoring in parallel lines with a medium or coarse scoring in parallel lines with a medium or coarse stable broom perpendicular to the direction of traffic or in direction as indicated on the drawings. Exact texture and harshness of the broom finish shall match the approved samples. Some areas require a medium broom finish, as indicated on the drawings or as directed by the Engineer/PIT.

5.13.4 Addition of Materials

The addition of cement, sand, water, or mortar to slab surfaces, while finishing concrete will not be permitted.

5.13.5 Slab Levels

a) All steel trowel finish and broom finish slabs, flatwork and paving shall finish true to 1: 500 on a straightedge in any direction.

b) Particular care shall be taken to finish toweling around the edges of the slabs so finish surfaces at edges shall be at same elevations as the rest of the top surface of the slab. Slabs shall be laid to temporary screeds set level at the proper elevations.

c) In areas where floor drains or catch basins occur, slope or pitch finish slab surfaces to the drains or catch basins as indicated on the drawings. Where slope is not indicated, it shall be a minimum of 1:100.

5.14 EXPANSION JOINTS

a) All joints shall be located as indicated on the Drawings and as hereinbefore specified.

b) For expansion joints, provide resin bonded cork joint filler of the size and thickness, where indicated on the Drawings, install with top edge 12mm below the surface and tool adjacent concrete edges to a 3mm radius. Use steel pins to hold material in place during placing and floating of concrete. After a minimum of 28 days after slabs have been placed and finished, fill tops of expansion joints with expansion-joint sealing compound to 3mm below surface of slabs. No traffic shall be permitted to travel over sealed joints until sealing compound is thoroughly dry.

c) Mark-off lines or edges at formed construction joints expansion or isolation joints, and other such joints where indicated shall be formed with 3mm or 6rnrn radius curved edging tool, neat and true to line, uniform throughout.

5.15 DEFECTIVE WORK

The following concrete work will be considered defective and may be ordered by the Consultant to be removed and replaced at Bidder's expense

a. Incorrectly formed.

b. Not plumb or level.

c. Not specified strength.

d. Containing rock pockets, voids, honey-comb, or cold joints.

e. Containing wood or foreign matter.

f. Not true to elevation.

g. Not pitched to drain when called for.

h. Not surfaced as specified,

i. With any loose or roughened or defaced surfaces.

j. Not true to 1:500 on straightedge in any direction,

k. Otherwise not in accordance with the intent of the Drawings and Specifications.

5.16 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 6 REINFORCING STEEL

6.1 SCOPE OF WORK

The work to be performed under the provision of this Section includes furnishing, cutting, bending and placing of all steel reinforcement for all reinforced cement concrete work as shown on the drawings and specified herein.

6.2 CODE AND STANDARDS

Pertinent provisions of the following listed codes and standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

6.2.1 American Concrete Institute (Aci) Current Issues-

ACI 301 Specification for Structural Concrete for Buildings, Chapter 5 - Reinforcement.

ACI 315 Manual of Standard Practice for Dental ling Reinforced Concrete Structures.

ACI 318 Building Code Requirements for Reinforced Concrete.

6.2.2 American Society for Testing and Materials (ASTM)

A82 Specification for Cold-Drawn Steel Wire or Concrete Reinforcement.

A615 Specification for Deformed and plain Billet-steel Bars for Concrete Reinforcement.

A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

6.2.3 American Welding Society (Aws)

AWS D1.4/D1.4M:2018 Structural Welding Code – Reinforcing Steel shall be followed for connecting reinforcement where applicable.

6.2.4 Bangladesh Standards

BDS ISO 6935-2:2021: Steel for the reinforcement of concrete – Part 2: Ribbed bars

BDS ISO-6892-1-2009: Metallic materials - Tensile testing – Part 1: Method of test at room temperature

BDS ISO-7438-2005: Metallic materials - Bend test.

6.3 MATERIALS

a) Reinforcing Bars: Reinforcing bars (rebar)shall be new, deformed, billet steel bars, conforming to strength, elongation, weight, bend and deformation requirement of BDS ISO 6935-2:2021 Grade B500DWR, with specified strength and other qualities as shown on the structural and other design drawings.

b) Welded Wire Fabric: Welded wire fabric shall be new, rectangular mesh, welded deformed steel wire fabric, conforming to ASTM A497. Gauge or diameter of wire and center-to-center spacing of wire shall be as indicated on the drawings.

c) Accessories: Reinforcement accessories, consisting of spacers, chairs, ties, pre-cast concrete blocks and similar items shall be provided as required for spacing, assembling, and supporting reinforcement in place.

   i. For footings, slabs and beams, use supports of precast concrete blocks and metal chairs. Concrete block shall be precast with required thickness and sufficiently cured for at least 14 days. Proportion shall not be less than 1:1.5:3 and compressive strength shall not be less than the parent concrete

   ii. For exposed-to-view concrete surface, where legs of supports are in contact with forms, provide supports with legs which are hot dip galvanized or plastic protected or stainless steel protected.

d) Tie Wire: Tie wire for reinforcement shall be No. 22 gauge or heavier, black or galvanized, mild or commercial grade soft steel wire.

6.4 SHOP DRAWINGS

a) Fully detailed shop drawings, including bending schedules and bending diagrams, shall be submitted by the bidder to the engineer/PIT for the review and approval. Shop drawings shall show fabricating and placing details and size and location of all reinforcing steel. Shop drawings shall be prepared in accordance with the applicable requirements and guidelines of ACI 315.

b) Shop drawings shall be of such detail and completeness that all fabrication and placement at the site can be accomplished without the use of contract drawings for reference. Shop drawings shall include number of pieces, sizes, and markings of reinforcing steel, laps and splices, supporting devices and accessories and any other information required for fabrication and placement

c) Contract drawing for air conditioning, anchor bolt schedule and locations, anchors, hangers, inserts, conduits, sleeves, steel rail and other steel Sections, and any other items to be cast in concrete shall be checked for possible interference with reinforcing steel. Required clearances shall be indicated on shop drawings.

6.5 IDENTIFICATION

Reinforcing steel shall be bundled and tagged with grades, sizes and suitable identification marks for checking, sorting and placing. Sizes and mark numbers shall cones pond to placing drawings and schedules. Tags and markings shall be waterproof and shall not be removed until steel is placed.

6.6 FABRICATION

a) General: Fabrication of steel will be in accordance with the specific details are not indicated, comply with the applicable specified.

b) Cutting and Bending: Cutting and bending shall be performed at a central location, equipped and suitable for the purpose. Bars shall be accurately cut and bent as indicated on the approved shop drawings. Bars shall be bent cold. Heating of bars for bending or straightening will not be permitted, Bars shall not be bent or straightened in any manner which will injure the material, Label all bars in accordance with bending diagrams and schedules, and secure like pieces in bundles if appropriate.

c) Welding: Welding of reinforcement, where indicated or approved, including preparation of bars, shall conform with the applicable requirements of AWS D1.4/D1.4M:2018. Welders shall be pre-qualified in accordance with AWS requirements. Useful penetration butt welds by the electric-arc method unless otherwise indicated or electric-arc method unless otherwise indicated or approved. Weld splices to develop 125 percent of the specified yield strength of the bars, or of the smaller bar in transition splices. Clean bars of oil, grease, dirt,

and other foreign substances and flame dry before welding. Preheat bars before welding. Stagger splices in adjacent bars.

d) Fabrication Tolerances: Where fabrication tolerances are not indicated on the drawings, comply with the applicable requirements specified in ACl301.

6.7 TESTING

a) Tests of reinforcing steel will be performed in accordance with applicable ASTM/ISO or BDS Standards and as directed by the Consultant. The Bidder will arrange for all testing and will pay for all work required of the Testing Laboratory. The test will be done for weight, tension, elongation, bend and deformation.

b) When independent laboratory testing is required by the Consultant, materials to be analyzed or tested shall be delivered to the Testing Laboratory by the Bidder. Specimens for testing shall be taken at random from bundles as delivered from the mill.

c) Further testing of material already delivered to jobsite may be waived by the Consultant, provided, proper certification has been furnished as hereinbefore specified.

d) All relevant mill and Laboratory test results for the materials supplied shall be submitted to the Consultant.

e) Measurement of M.S works shall be given for the linear measurement of reinforcement and the weight shall be calculated according to the following Standard: BDS ISO6935-2:2021.

f) Specification of weight of 1000 kg = 1 Ton

g) No extra claim on account of over-weights of rods used than the above standards will be entertained. The Bidder shall take into consideration any such difference in weights of rods in the unit price while tendering, payment for M.S. work shall be made as per approved Bar Bending Schedule for steel reinforcement works.

6.8 PLACING

a) General: Reinforcing steel shall be placed in accordance with the drawings and approved shop drawings and the applicable requirements of the codes and

standards hereinbefore specified. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.

b) Reinforcing Supports: Bars shall be supported on metal chairs or spacers, or concrete blocks, fully cured, accurately placed and securely fastened to steel reinforcement in place at a spacing not less than 1 block per 1 sqm for slab and 1 block per running 1m for beam or as directed by the Consultant. Additional bars shall be furnished whether specifically shown on drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in the form surface. Hopping and stirrups shall be accurately spaced and wired to the reinforcing. No wood will be permitted inside forms.

c) Placing and Tying: Reinforcing shall be set in place, and rigidly and securely tied or wired with steel tie wire at all splices and all crossing points and inter-Sections in the positions shown. Rebinding of bars on the job to fit existing conditions will not be permitted without written authorization of the Consultant. Point ends of wire ties shall be away from forms.

d) Spacing: Centre-to-centre distance between parallel bars shall be in accordance with the drawings or, where not indicated, the clear spacing shall be nominal bar diameter but in no case less than 25mm nor less than 1-1/3 times the maximum size aggregate as directed and approved by the Consultant.

e) Splices: Laps of splices shall be adequate to transfer stress by bond. Unless indicated otherwise on the drawings, lap bars a minimum of 40 bar diameters with hook. Wherever possible, splices of adjacent bars shall be staggered a minimum lap length.

f) Welded wire Fabric: Wire fabric shall be in as long lengths as practicable and shall be wired at all laps and splices. End laps shall be offset in adjacent widths. Laps shall be a minimum of one full mesh plus 50mm, welded wire fabric shall be secured in position with suitable supports, accessories, and tie wire as indicated and required to ensure against movement from workmen and placement of concrete.

g) Dowels: Provide dowels where indicated or required. Dowels shall be tied securely in place before concrete is deposited. Provide additional bars for proper support and anchorage where required. Where sleeves are required for dowels for load transfer in slabs, or for other dowels, sleeves shall be black or galvanized steel pipe, standard weight, of size required to clear dowel 3mm all around.

h) Protective Concrete clear covering: Except where indicated otherwise on drawings, the minimum concrete coverage for steel reinforcement shall be as follows-

Sl.	Description	Clear cover
1	Where concrete is placed against earthen trench/forms (except shore pile)	75mm
2	Slabs on grade or against earth	50mm
3	Walls below grade; columns	50mm
4	Walls above grade and slab bottom	38mm
5	All other formed concrete which willbe exposed to earth	50mm

j)Placement Tolerances: Where placement tolerances are not indicated on the drawings, comply with the applicable requirements specified in ACI-301. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. lf bars are moved more than one bar diameter, or enough to exceed specified tolerances, the resulting arrangement of bars shall be subject to the Consultant acceptance.

6.9 CLEANING

Reinforcement, when in place, shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign materials.

6.10 NOTIFICATION AND INSPECTION

Bidder shall notify the Consultant at least 72 hours ahead of each concrete pour, and no concrete shall be placed until all installed reinforcing steel has been inspected and approved by the Consultant.

6.11 CORRECTION DURING CONCRETE PLACEMENT

Capable steel workmen shall be kept on the work at all times during the placing of concrete, and they shall properly reset any reinforcement displaced by runways, workmen, or other causes. Reinforcement shall not be bent after being partially embedded in hardened concrete.

6.12 DEFECTIVE WORK

The following reinforcing steel work will be considered defective and may be ordered by the Consultant to be removed and replaced by the Bidder at no additional cost to the Employer.

i. Bars with kinks or bends not indicated on drawings;

ii. Bars injured due to bending or straightening

iii. Reinforcement not placed in accordance with the drawings and/ or specifications

6.13 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 7 PILE FOUNDATION

7.1 PRECAST CONCRETE DRIVEN PILES

7.1.1 Description

This work shall consist of precast reinforced or prestressed concrete piles furnished and driven in accordance with these Specifications and in conformity with the requirements shown on the Drawings or elsewhere in the Contract Documents.

The type and sizes of piling to be used shall be as indicated on the Drawings. Where precast concrete driven piles have been used for the design, the Engineer /PIT shall consider and may give approval for the use of alternative types of piling proposed by the Bidder. The Bidder in submitting an alternative type of pile shall provide design data, piling experience records and calculations supporting the pile design and any variations in the substructure.

7.1.2 Materials

7.1.2.1 Concrete

Precast concrete piles shall be constructed in accordance with the details shown on the Drawings, and of the concrete class, proportions, method of mixing and placing in accordance with the provisions of Chapter 5. All cement used shall be in accordance with Chapter 5 and concrete shall contain not less than 350 kg of cement per cubic meter.

The cross sectional dimensions of the pile shall be not less than those specified and shall not exceed them by more than 10 mm.

Any face of a pile shall not deviate by more than 6 mm from a straight edge 3 meters long laid on the face, and the centroid of any cross section of the pile shall not deviate by more than 1/1,000 of the length of the pile from the straight line connecting the centroids of the end faces of the pile.

7.1.2.2 Formwork

The formwork for square precast concrete piles shall conform to the general requirement for concrete formwork as described of Chapter 4.

The head of each square pile shall be square to the longitudinal axis. The corners of the head and the corners of the pile shaft for a distance of 300 mm from the head shall be chamfered 25 mm x 25 mm.

7.1.2.3 Prestressing Steel

All prestressing steel shall comply with ASTM A416 or ASTM A421 whichever is applicable. All prestressing shall be of grade 270 [1860 MPa tensile strength]. All prestressing tendons shall comply with the details shown on the Drawing as to the quality, size, position and prestressing force introduced to the pile.

7.1.2.4 Reinforcement

Reinforcement steel shall be in accordance with the provisions set out in specifications of Chapter 6 and positioned as shown on the Drawings.

7.1.3 Production of Piles

7.1.3.1 Casting

Square piles shall be cast in a horizontal position. Special care shall be taken to place the concrete so as to produce a pile free from any air pockets, honeycombing or other defect.

Concrete shall be placed continuously and shall be compacted by vibrating or by other means satisfactory to the Engineer. The forms shall be slightly overfilled, the surplus concrete screeded off, and the top surfaces finished to a uniform, even texture similar to that produced by the forms.

Piles may only be constructed in separate shorter elements with the approval of the Engineer. Joints made after casting and/or stressing shall be at least as strong as the piles themselves in every respect.

7.1.3.2 Tensioning Procedure (Pre stressed Piles Only)

Tensioning shall be carried out only in the presence of the Engineer/PIT, or his representative, unless otherwise approved in writing.

As used here the word “tendon” shall be defined as any single pre stressing element used to apply pre stressed forces to the concrete. For pre-tensioning this shall be each strand or straight wire.

All tendons to be stressed in a group shall be brought to a uniform tension of approximately 500 kilograms per tendon prior to being given their full tension. After this initial stressing the group shall be stressed to a total tension as required on the Drawings by means of hydraulic jacks or other approved appliances equipped with gauges graduated to read directly to 1% of the total load applied, and calibrated to measure accurately the stress

induced in the steel. This induced stress shall be measured by elongation of the tendons and checked by gauge pressure. The results obtained shall be within 5% of each other.

Means shall be provided for measuring the elongation to an accuracy of one millimeter in twenty metres of length between jacking heads. In the event of apparent discrepancies of more than five percent between stresses indicated by gauge pressure and elongation, the entire operation shall be checked carefully and the source of error determined and corrected before proceeding further.

Independent references shall be established adjacent to each anchorage to indicate any yielding or slippage that may occur between the time of initial stressing and final release of the tendons.

7.1.3.3 Curing

Curing of the concrete shall be commenced prior to the formation of surface shrinkage cracks and as the concrete has hardened sufficiently to prevent injury. Curing shall conform to the requirements of Chapter 5.

7.1.3.4 Release (Pre tensioned Piles Only)

For precast pre tensioned members the tendon stress shall be maintained between anchorages until the concrete has reached a compressive strength equal to the “Transfer Strength” specified on the Drawings. After strength requirements are attained, the tension in the tendons shall be gradually and simultaneously released and the tendons cut off as required in such a way as to prevent shock. It shall be the Bidder's responsibility to transfer the prestress safely and to the Engineer's satisfaction in all respects.

A recess shall be cut at the ends of piles around each tendon to allow cutting off the tendon and filling the recess with grout so that the cover to the end of the tendon is not less than 20 mm.

7.1.3.5 Finishing

Piles shall present a true, smooth, even surface free from any surface blemishes and true to the dimensions shown on the Drawings, within the tolerance limits.

7.1.3.6 Marking of Piles

After a pile has been cast, the date of casting, reference number, length and, where appropriate, the pre stressing force shall be clearly inscribed on the top surface of the pile and

also clearly and legibly marked on the head of the pile. In addition, each pile shall be marked at intervals of 250 mm along the top 3 meters of its length before being driven.

7.1.3.7 Handling and Storage of Piles

The method and sequence of lifting, handling, transporting and storing piles shall be such that the piles are not damaged. The lifting point of each size of pile shall be proposed by the Bidder with supporting calculations for approval of the Engineer /PIT which verifies the pile will not be damaged during lifting, handling, transporting and storage. During transport and storage, piles shall be stored on adequate supports located under the lifting points of the piles.

Concrete shall at no time be subjected to loading, including its own weight, which will induce a compressive stress in it exceeding one third of its strength. For this purpose the assessment of the strength of the concrete and of the stresses produced by the loads shall be subject to the agreement of the Engineer.

All piles within a stack shall be in groups of the same length. Packings of uniform thickness shall be provided between piles at the lifting points.

7.1.3.8 Spliced Piles

Where the Drawings do not detail any splices in piles, the Bidder may adopt spliced piles provided details of the splicing method and drawings are submitted to the Engineer /PIT for approval prior to the manufacture of the piles.

7.1.4 Driving Piles

7.1.4.1 Strength of Piles

Piles shall not be driven until the concrete has achieved the specified 28 day strength.

7.1.4.2 Leaders and Trestles

At all stages during driving and until incorporation in the superstructure, the pile shall be adequately supported and restrained by means of leaders, or other guide arrangements to maintain position and alignment and to prevent buckling. These arrangements shall be such that damage to the pile does not occur. Leaders shall be of sufficient length to make the use of followers unnecessary.

7.1.4.3 Driving Equipment

Before any piling work is commenced the Bidder shall submit to the Engineer /PIT full details of the pile driving equipment and the method he intends to use in carrying out the work.

For special types of piling, driving head mandrels, or other devices in accordance with requirements shall be provided so that piles may be driven without injury.

The driving equipment shall be of a type which assures that the energy needed to penetrate the pile to the required depth is transmitted to the pile head without damaging the pile. Efficiency factor of the hammer, i.e. The relation between the theoretical energy developed by the hammer and the energy submitted to the pile, shall be minimum 0.7.

Piles shall be driven with steam, air, diesel or gravity hammers. When diesel hammers are used, they shall be calibrated by load tests if necessary.

When gravity hammers are used for driving concrete piles, the drop of the hammer shall not exceed 1.0meter and the hammer shall have a weight of not less than 80% of the weight of the pile and the driving head. The fall shall be regulated so as to prevent injury to the pile.

The minimum energy developed by other types of hammers shall be the same as specified for gravity hammers.

7.1.4.4 Driving Procedure and Redrive Checks

Each pile shall be driven continuously until the specified or approved set and/or depth has been reached, except that the Engineer /PIT may permit the suspension of driving if he is satisfied that the rate of penetration prior to the cessation of driving will be substantially re-established on its resumption or if he is satisfied that the suspension of driving is beyond the control of the Bidder. A follower (long dolly) shall not be used.

The Bidder shall inform the Engineer /PIT without delay if an unexpected change in driving characteristics is noted. A detailed record of the driving resistance over the full length of the nearest available pile shall be taken if required.

At the start of work and in a new area or section, sets shall be taken at intervals during the last 3.0meters of the driving to establish the behavior of the piles.

The Bidder shall give adequate notice and provide all facilities to enable the Engineer /PIT to check driving resistances. A set shall be taken only in the presence of the Engineer /PIT unless otherwise approved.

Redrive checks, if required, shall be carried out to an approved procedure.

7.1.4.5 Final Set

The final set of each pile shall be recorded either as the penetration in millimeters per 10 blows or as the number of blows required to produce a penetration of 250 mm.

a) The exposed part of the pile shall be in good condition without damage or distortion.

b) The dolly and packing, if any, shall be in sound condition.

c) The hammer blow shall be in line with the pile axis and the impact surfaces shall be flat and at right angles to the pile and hammer axis.

d) The hammer shall be in good condition and operating correctly.

e) The temporary compression of the pile shall be recorded if required.

7.1.4.6 Driving Sequence and Risen Piles

Piles shall be driven in an approved sequence to minimize the detrimental effects of heave and lateral displacement of the ground

When required, level sand measurements shall be taken to determine the movement of either the ground or of any pile which results from the driving process.

When a pile has risen as a result of adjacent piles being driven, the Bidder shall submit to the Engineer /PIT his proposals for correcting this and the avoidance of it in subsequent work.

7.1.4.7 Jetting

Water jetting shall not be allowed. Continuous vibratory percussive methods shall be used to drive a pile to both its design depth as well as the required set where the upper strata affords high resistance to driving.

7.1.4.8 Length of Piles

The lengths of the piles shown on the Drawings are based on information which has been obtained from a site investigation prior to the driving of test piles.

Before pile lengths are finally settled, the Bidder shall construct to the lengths shown on the Drawings such pilot piles as may be found necessary and these piles shall be driven in the positions specified by the Engineer /PIT who shall be notified in advance of the driving. The Bidder shall furnish the Engineer /PIT daily with a detailed record of the pilot piles for the full depth of driving. After attaining the approved set, driving shall be continued until the Engineer /PIT directs that it shall cease. Driving of pilot piles beyond the point at which the approved set is obtained shall be called for to demonstrate that driving resistance continues to increase. The Bidder shall then provide the remainder of the piles. In determining the lengths of piles the Bidder shall base his order list on the lengths assumed to remain in the completed structure. The Bidder at his own expense can increase the lengths to provide for fresh heading and for such lengths as may be necessary to suit his method of operation.

7.1.4.9 Repair Or Damaged Pile Heads

When repairing the head of a pile, the head shall be cut off square at sound concrete, and all loose particles shall be removed by wire brushing, followed by washing with water. If the pile is to be subjected to further driving, the head shall be replaced with concrete of an approved grade.

If the driving of a pile has been accepted but sound concrete of the pile is below the cut-off level, the pile shall be made good to the cut-off level with concrete of a grade not inferior to that of the concrete of the pile.

Repaired piles shall not be driven until the added concrete has reached the specified characteristic strength of the concrete of the pile.

7.1.4.10 Cut Off and Extension

Prestressed concrete piles shall be cut off at such elevation that they shall extend into the cap or footing as indicated on the Drawings. In the case of hollow core piles starter bars shall be cast into the core at the top of the piles and extended into the cap or footing, all as shown on the Drawings. Extensions to prestressed concrete piles shall generally not be permitted, unless a provision for lengthening prestressed piles was incorporated at the time of manufacture. Any method for lengthening shall be such that joints are capable of taking safely the stresses during driving and under load.

7.1.4.11 Damage to Adjacent Structures and Services

The Bidder will take all necessary precautions to avoid damage to any adjacent structures and services. If during the execution of the work damage is, or is likely to be,

caused to any adjacent structures or services, the Bidder shall submit to the Engineer /PIT his proposals for repair or avoidance of such damage.

7.1.4.12 Records

The Bidder shall keep records as indicated below of the installation of each pile and shall submit two signed copies of these records to the Engineer /PIT not later than noon of the next working day after the pile is installed. The signed records shall form a record of the work.

The following data are required-

a) Pile location

b) Pile reference number

c) Pile type

d) Nominal cross-sectional dimensions or diameter

e) Length of preformed pile

f) Date and time of driving or redriving

g) Ground level at commencement of installation of pile

h) Working level

i) Pile toe level

j) Type, weight, drop and mechanical condition of hammer and equivalent information for other equipment

k) Number and type of packing used and type and condition of dolly used during driving the pile

l) Set of pile in mm per 10 blows or number of blows per 250 mm of penetration

m) If required, the sets taken at intervals during the last 3 metres of driving

n) If required, temporary compression of ground and pile from time of a marked increase in driving resistance until pile reaches its final level

o) All information regarding obstructions delays and other interruptions to the sequence of work

7.1.5 Tolerances

7.1.5.1 Setting Out

Setting out shall be carried out from the main grid lines of the proposed structure. Before installation of the pile, the pile position shall be agreed with the Engineer /PIT and marked with suitable identifiable pins or markers.

7.1.5.2 Position

For a pile cut off at or above ground level the maximum permitted deviation of the pile centre from the centre point shown on the setting out drawing shall be 75 mm in any direction.

7.1.5.3 Verticality

The maximum permitted deviation of the finished pile from the vertical shall be 1 in 50.

7.1.5.4 Rake

The piling rig shall be set and maintained to attain the required rake. The maximum permitted deviation of the finished pile from the specified rake shall be 1 in 25.

7.1.6 Defective Piles

The procedure of driving the piles shall not subject them to excessive and undue abuse producing crushing and spalling of the concrete or deformation of the steel. Manipulation of piles to force them into proper position, considered by the Engineer /PIT to be excessive, shall not be permitted. Any pile damaged by reason of internal defects, or by improper driving or driven out of its proper location or driven below the elevation fixed by the plans or by the Engineer, shall be corrected at the Bidder's expense by one of the following methods approved by the Engineer /PIT for the pile in question-

a) The pile shall be withdrawn and replaced by a new and if necessary, a longer pile.

b) A second pile shall be driven adjacent to the defective or low pile.

c) The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to properly embed the pile.

7.1.7 Measurement

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on

measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

7.2 PILE LOAD TEST IN COMPRESSION

Compression capacity of piles (driven or cast-in-situ) shall be tested following static maintained load method (ML) to ensure that their capacity conforms to the design requirement. The determination of allowable and ultimate load capacity from pile load tests shall be in accordance with Indian Standard IS: 2911 Part-4 as described in BNBC 2020. Testing procedure and specification and interpretation of the results shall be in accordance with the provisions of BNBC 2020, Part 6, Chapter 3, Sec. 3.11.2 and ASTM D1143/D1143M-07. Some specific requirements of the pile load testing procedure are given in the following paragraphs.

Tests till the ultimate compression failure of the piles shall be carried out on separately driven sacrificial test piles. However, the test load need not to exceed 3.0 times the allowable compression capacity of the pile. Number of such test piles shall be as follows.

Facility	Number of sacrificial test piles
Repair Facility	04 Nos.
Slipway	09 Nos.

These piles shall be discarded (or shall remain unused) after testing. Precise location of the installation of test piles shall be decided by the Engineer /PIT. After performing these tests, the pile compression capacity shall be verified and finalized for design of structures. If the verified/finalized allowable capacity is less than the capacity indicated on the drawings, the pile foundation design of the relevant facility (e.g. slip way, repair facility, buildings etc.) shall be revised accordingly by the bidder/bidder.

In addition, tests shall be carried out on at least 1.0% (one percent) of the service piles. The maximum test load shall be 150% of the allowable design capacity of the piles. Such service piles shall be used as a part of the foundation after testing if the pile passes the test. Selection of such test pile samples shall be such that proportionate representation of the buildings and structures are maintained. Exact selection of the piles to be tested shall be made

by the Engineer /PIT. The bidder shall remain responsible to replace any damaged pile that occurs during static pile load test without any extra cost.

The bidder shall remain responsible for any and all design changes, specifically the design of pile foundations, based on the outcome of the pile load tests. Any extra cost of design and construction/installation as a consequence of such design revision of the pile foundation or any other component shall be borne by the bidder and such extra cost shall not affect the contract price, i.e. such extra expenses shall not be compensated/reimbursed by the Owner.

7.3 PILE INTEGRITY TEST

In order to check the structural integrity of the piles, Pile Integrity Tests shall be performed on all the driven piles in accordance with the procedure outlined in ASTM D5882 and as described in BNBC 2020, Part 6, Chapter 3, Sec. 3.11.1. If any pile is subjected to static load test, then Pile Integrity Test shall be carried on that pile after finishing the static load test. If any pile, after integrity test, is found unsatisfactory in the opinion of the Engineer /PIT for utilization in the structure, the pile shall be replaced as directed by the Engineer /PIT. All extra expenses shall be borne by the bidder and such expenses shall not be compensated/reimbursed by the Owner.

CHAPTER 8 EXPANSION, ISOLATION AND CONSTRUCTION JOINTS

8.1 SCOPE OF WORK

The work covered under this item shall consist of providing expansion, isolation and construction joints in roofs, walls, floors, raft elsewhere in accordance with applicable plans, schedule and specifications.

8.2 DESCRIPTION OF WORK

a) Roof expansion joint, if any, shall be covered by 2 layers of bituminous water proofing felt including two coats of hot bituminous paint, sealing, joints by 150mm over plans, heating by blow torch, clearing and preparing and drying bed as required.

b) Wall Expansion Joint, if any, shall be provided with two stands of bitumen impregnated coir rope tightly wedged place and covered on the interior face with aluminum cover with snap-in clip as per drawing.

c) Floor expansion joint, if any, shall be provided with sand bituminous mastic. Clean coarse (about 2.5 FM) shall be thoroughly mixed with hot bitumen in the ratio of 100 kg. Of bitumen 1 Cum. Of sand and the resulting mastic, while still hot, shall be carefully poured and rammed into the full depth of the expansion joint as shown in drawing.

d) Construction joints in wall, floors, raft, slabs, roof elsewhere necessary to be provided as per drawing, specification and instruction of the Consultant. The works include shaping the joints, removing the loose materials, cleaning, grouting with the recommended dosages of admixtures,

8.3 METHOD OF MEASUREMENT

No extra payment will be entitled for these works. These works are considered as a part of RCC works.

CHAPTER 9 MASONARY WORK

9.1 SCOPE OF WORK

The work to be performed under the provision of this Section includes furnishing and installation of all brick masonry work as shown and noted on the drawings and as specified herein.

9.2 SAMPLES

Bidder shall furnish at least 5 full-size samples of 1st class machine made bricks proposed for use to the Consultant for approval.

9.3 MATERIAL

9.3.1 Machine Made Bricks

a) Brick shall conform with ASTM C62 grade, or equal. General requirements include the following to be tested by BRTC, BUET for approval by the Consultant. Cost of tests shall be borne by the bidders.

	Average of 5 bricks	Individual bricks
Minimum compressive strength	30MPa	26MPa
Maximum saturation coefficient, which is the ratio of absorption by 24 hours submersion in cold water to that by 5-hour boiling	6%	8%
Bricks shall be machine moulded, oven baked		
The weight of one brick	3.30 kg.	3.30 kg
Efflorescence and salinity when tested in laboratory	Nil	Nil

b) Machine made bricks shall be made from required quality of brick firing clay, free from saline deposits, and shall be thoroughly oven-baked without being vitrified, of uniform color, regular uniform in site, and texture, with sharp square edges and parallel faces and shall comply with requirements as in (a) above.

c) Machine made ceramic bricks of any other types shall be of the site shown on the drawings and specified herein and they shall be a standard commercial product of approved manufacture, submit sample and technical literature to the Consultant for approval, Bricks require approval before they may be used in the work.

9.3.2 First Class Bricks

a) Brick shall conform with ASTM C62 grade, or equal. General requirements include the following to be tested by BRTC, BUET for approval by the Consultant. Cost of tests shall be borne by the bidders. The test will be done for compressive strength, absorption and Salinity. The frequency of test 1 set of samples for every 15000 no's of Brick.

	Average of 5 bricks	Individual bricks
Minimum compressive strength	182kg/cm^2	140kg/cm^2
Maximum water absorption by hour boiling test, percent	22	20
Maximum saturation coefficient, which is the ratio of absorption by 24 hours submersion in cold 'later to that by 5-hour boiling	0.88	0.76
Size of bricks, 70mm Bricks shall be pug mill moulded, oven baked by trench kiln	240 × 114 × 70mm	240 × 114 ×
The weight of one brick	4.30kg	4-4.5kg
Efflorescence and salinity when tested in laboratory	Nil	Nil

b) First class bricks shall be made of specified quality of brick firing clay, free from saline deposit and shall be thoroughly oven-baked without being vitrified, of uniform colour, regular uniform in size, and texture, with sharp square edges and parallel faces and shall comply with requirements as above.

c) Bricks shall be homogeneous in texture and shall emit a clear metallic ringing sound when struck one against the other. They shall be free from flaws, cracks, chips, stones, modules of lime or kankar, and other blemishes. A first class brick shall not

absorb more than 1/6th of its weight of water after being soaked for 24 hours, and shall show no signs of efflorescence on drying.

d) Bricks not meeting the above requirements shall not be used under any circumstances.

9.3.3 Cement

Cement shall be specified in the specification in the Concrete works.

9.3.4 Fine Aggregate

Fine aggregate shall be specified in the specification in the

Concrete works. The F.M of sand shall not be less than 1.5.

9.3.5 Water

Water shall be specified in the specification in the Concrete works.

9.4 MORTAR

a) Cement mortar shall consist of a mixture by weight or volume of cement to by weight or volume of fine aggregate. Mixed in proportion as specified in schedule of work or as shown in drawing. The method of mixing mortar, either by weight or volume, requires approval of the Consultant.

b) The cement and sand (F.M. 1.50) shall be mixed dry in 1:4 (cement: sand) proportion unless otherwise specified elsewhere until the colour of the mixture is, uniform. Approved water shall then be added sparingly, only the minimum necessary being used to produce a workable mixture of normal consistency. The water/cement ratio shall not exceed 0.50 by weight unless directed otherwise by the Consultant.

c) All mortar shall be machine mixed or hand mixed on approval by the Consultant.

d) Mortar shall be mixed in such quantities as can be used in the work within 30 minutes after mixing with water. Mortar which has taken initial set shall not be used nor shall it be remixed with fresh mortar, and such mortar shall be discarded.

9.5 INSTALLATION AND WORKMANSHIP

a) Brick masonry work shall be built to dimensions indicated on the drawings, plumb, curved or battered, as required, by skilled masons and workmen properly

supervised, Brick shall be thoroughly washed and soaked in water for at least 4 hours before use.

b) All joint vertical or horizontal shall be filled full with mortar Horizontal joint shall be parallel, level and straight; vertical joint in alternate courses shall be directly over one order. Joint thickness shall not be less than 6mm and not more than 10mm. The height of four bricks with four bed shall not exceed 300mm.

c) Joint of exposed brickwork shall be raked and concave pointed or as shown in drawings or specified elsewhere. The surface of the exposed brick work shall always be kept clean and free from mortar stains. A wooden template shall be used for uniformity of the joint thickness.

d) Where new work joins previous work, the latter shall be well cleaned and thoroughly watered. All face work bricks shall be specially selected regarding size, shape and edges. Brick for 250mm walls, shall be laid in stretcher Bond, or as shown in drawing or directed by the Consultant with frogs (manufacture/s trademark) mark upward. Brick for 125mm walls shall be laid in common bond.

e) In cavity walls, two walls with cavity in between as soon in drawings shall be tied together with metal 12 SWG ties at 375mm c/c vertically and 900mm on centre horizontally if not shown otherwise in drawing. The cavity shall be kept clean of mortar, spills or any other materials, all through and a damage c.c. bed as per drawing shall be built at DPC level. Venetian holes at approx. 90mm spacing shall be provided in the exterior wall by omitting mortar every fourth vertical joints starting immediately above the DPC unless otherwise shown in the drawing or instructed by the Consultant.

f) Height of brick work for a days work shall be limited to 1200mm for 125mm wall and 1500mm for 250mm wall.

g) All embedded metal items shall be installed as the masonry work progresses. Locations shall be as indicated on the drawings,

h) All brick work shall be thoroughly cured for at best 7 days or as directed by the Consultant.

9.6 CORBELLING, COPING, CORNICES, STRING, COURSE ETC.

a) All corbelling, brick coping's, cornices, string courses, window sills, drip courses and brick footings or foundations shall consist of first class ceramic brick work laid in cement mortar as specified above.

b) All work shall be performed in accordance with the drawings and this specification.

9.7 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 10 BRICK FLAT SOILING

10.1 SCOPE OF WORK

The work covered by this item shall consist of supplying and laying bricks on top of the earth sand bed or anywhere as shown in the drawings to form a sub base.

10.2 DESCRIPTION OF WORKS

Bricks shall comply with requirements of first-class brick unless otherwise required by the Consultant. The blinding sand will have F.M:1.5 and shall be clean, free from organic matters. Brick shall be laid flat in surface to surface contact with adjoining bricks and their joints shall be filled with sand. The sand shall be brushed in until the joints are filled. Flushing of sand with water will not be done unless permitted.

10.3 METHODS OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 11 CERAMIC BRICK CLADDING

11.1 SCOPE OF WORK

The work to be performed under the provision of this Section includes furnishing and fixing of machine made Ceramic bricks over vertical faces of outer wall as shown and noted on the drawings and as specified herein.

11.2 SAMPLE

The bidder shall furnish at least 5 full-size samples of Ceramic bricks proposed for use in this work to the Consultant for approval.

11.3 MATERIALS

a) General requirements include the following to be tested by BRTC, BUET/CUET for approval by Consultant. Cost of tests shall be borne by the bidder.

Compressive strength (minimum)	28 MPa
Maximum water absorption by 5 hr. boiling test	4%
Weight of one brick	0.8kg
Efflorescence and salinity when tested in laboratory	Nil
Size of one brick	200mm x 62mm x 25mm
Color of bricks	: as specified by the consultant

Bricks will be machine made

b) Ceramic bricks shall be of the size shown on the drawings and specified here above in (a) above without being vitrified, uniform yellowish color, regular uniform in size and textures with sharp square edges and parallel faces and shall comply with requirements as (a) above. Bricks shall be homogeneous in texture and shall be free from flows, cracks and offer blemishes. Color of bricks will not be faded by any weather action.

c) Bricks not meeting the above requirements shall not be used under any circumstances

11.4 MORTAR

a) Cement mortar shall consist of a mixture by weight or volume of cement to weight or volume of fine aggregate mixed in proportion (1:4) or as specified in schedule of work or as shown in drawing. The method of mixing mortar, either by weight or volume, requires approval of the Consultant.

b) The cement and sand (F.M.1.50) shall be mixed dry in the specified proportions until the colour of the mixture is uniform. Approved water shall then be sprinkled, only the minimum necessary to produce a workable mixture of normal consistency, the water - cement ratio shall not exceed 0.50 by weight unless directed otherwise by the Consultant.

c) All mortar shall be machine mixed or hand mixed on approval by the Consultant.

11.5 INSTALLATION AND WORKMANSHIP

a) Ceramic brick-cladding work shall be done to dimension indicated on drawings, plumb, curved or battered as required by skilled masons and workmen properly supervised. Bricks shall be thoroughly washed and soaked in water for at least 4 hours before use.

b) Brick surface receiving cladding work shall be finished with rough plaster as per specification of plaster work.

c) All joints vertical or horizontal shall be filled full with mortar. Horizontal joint shall be parallel, level and straight. Vertical joints in alternate courses shall be directly over one another. Joint thickness shall not be more than 6mm.

d) Joints of brickwork shall be raked and concave pointed or as shown in drawings or specified elsewhere. The surface of the exposed brick shall be kept clean and free from mortar stains.

e) Where new work joins previous work, the later shall be well cleaned and thoroughly watered.

f) Height of work for a day shall be limited to 900mm.

g) All brick works shall be thoroughly cured for at least 7 days or as directed by the Consultant.

11.6 METHOD OF MEASUREMENTS

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 12 MISCELLANEOUS METAL

12.1 SCOPE OF WORK

The work of this section consists of furnishing unless otherwise mentioned and installing all miscellaneous metal work as shown on drawings and not specifically required to be provided under other sections of specifications

12.2 GENERAL REQUIREMENT

a) All materials shall be of new stock, free from defects impairing strength, durability or appearance, and of best commercial quality for the purpose specified.

b) All anchors, bolts and other, parts required for securing each item of work to the construction shall be new and included in the work.

c) The bidder shall take and verify all measurements at the building as may be necessary or required. He shall be responsible for all field dimensions, all fittings and the proper attachment of all work included herein

12.3 MATERIALS

a) All structural shapes including beams, channels, angles, plates, and rivets shall conform to the latest revision of ASTM A-6 and 36 standard specifications of Structural Steel for Building.

b) Brass shall be Red Brass, conforming to ASTM Specifications Designation B-36 as amended to date.

12.4 SHOP DRAWINGS

a) Prime drawings shall be submitted for all the items of work under this section to the Consultant for approval.

b) Prime drawings shall be completed and show size, typical and special details method of installation, type and location of fastenings gauge of metal and all other necessary information.

12.5 FABRICATION

a) All foreign materials shall be removed and deformations be rectified prior to sizing for fabrication.

b) Cutting shall be done in a neat and workmanlike manner without damaging the Sections. All cuts shall be made square, precise and true to dimensions shown on drawings.

c) The ends of all members shall be carefully reamed out free from burrs before fabrications and shall be checked carefully against deformations and if required such defects shall be rectified.

d) Tubular Sections shall be bent true to profile without any deformation using bending equipment's.

e) Fabrication work shall be neat, true to plumb, square, true to dimension and profile, accurately fitted with tight joints and inter-sections.

f) All exposed welded joints shall be grounded smooth without impairing the strength of the joint, Necessary procedures must be adopted prior to making such joints.

12.6 SHOP COATING

a) All work shall be as detailed in drawings and except for galvanized metal brass or bronze, be furnished to the site with one prime coat of red lead oxide unless otherwise required by the Consultant /PIT. Antirust prime-coat shall be approved by Consultant

b) Before applying approved antirust prime coat all rust, loose milled scale, dirt, welding flux, spatter and other foreign materials shall be removed with wire brushes or steel scrapers. All grease and oil shall be removed by solvent recommended by paint manufacturer. Surfaces shall be dry when painted.

c) Dissimilar metals shall be insulated from each other with one heavy coat of asphalt paint on contact surfaces in addition to the prime coat specified above.

d) Prime coat shall be thoroughly and evenly applied and shall he well worked into corners and joints taking care to avoid sags and runs. Bolts which are to remain permanently in the work shall be dipped in paint to cover the entire bolt

e) Prime coat shall be omitted from surfaces to be embedded in concrete or masonry. Also, prime coat shall be omitted from surfaces to be welded in the field, except where the primer used can be conclusively shown to have no adverse effect on the weld.

12.7 ERECTION

a) All materials shall be carefully handled and stacked to prevent deformation and damage. Care shall be taken to prevent damage to the prime coat of paint and to prevent the accumulation of mud, dirt, or other foreign matter on the metal work. All such dirt shall be removed prior to erection.

b) Work shall be erected square, true to plumb, accurately fitted, and with tight joints and inter-Sections. All connections which will be exposed shall be welded and ground smooth unless otherwise shown.

c) All anchorage and other members to be set in concrete or masonry shall be built in as the work progresses, later cutting or drilling shall be avoided as far as practicable.

d) After erection, all portions shall be with another coat of some prime coat.

e) Welded field connections in galvanized work shall be hot zinc, coated in the field with Gal alloy galvanizing compound, or approved equal, applied in accordance with manufacture/s instructions,

12.8 FRAMES, GRILLS, TRUSS WORK AND COLLAPSIBLE GATE

a) Frames, Grills, Truss work, collapsible gate etc. shall be made of M.S. Sections as detailed in drawing.

b) Fabrication shall be true to shape and dimension, level and square. All joints shall be welded full length as and where required as per drawing and direction of the Consultant and shall be neat and clean and free of welding fluxes, All blisters and welding joints shall be filed plane before erection.

c) It will have finish and colour as shown in drawing or as directed by the Consultant

12.9 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 13 WOOD WORK

13.1 SCOPE OF WORKS

It covers manufacturing and supply of wood doors, wood windows, cabinet or other item as finished items in accordance with drawings including arranging/installing them in proper position, care and maintenance as per contract.

Bidder shall supply the sample of wood to the Consultant for Employees approval within 7 (seven) day of 'receipt of work order. All the timbers required for the work have to be mobilized at site at a time within one month of receipt of work order. The test will be done for Moisture content, Compression test, Hardness test and Flexure test.

13.2 GENERAL REQUIREMENTS

a) Design drawings shall be thoroughly studied by the Bidder before the work is commenced. Detail of joints shown in the drawings must particularly be checked. If any detail description or specification is found missing or in the opinion of the Bidder inadequate, inconsistent or otherwise, the Bidder should invite the attention of the Consultant who may make necessary amendments as he deems fit. On no account shall the Bidder use his own judgments when any design drawing, details, description found wanting

b) Shop drawings must be got approved by the Consultant prior to starting manufacture of samples or in lieu thereof samples of typical joinery must be got approved by the Consultant /PIT.

c) Dimensions shown on drawings are finished dimensions, Therefore in sizing rough components necessary allowance must be kept for working loss i.e. planning, smoothening and finishing.

d) As soon as practicable after the execution of contract and before any material, fixture or fitting are purchased, the Bidder shall submit to Consultant. samples of materials, fixtures or fittings as required along with particulars if applicable, substantiated by catalogues if possible for his approval.

e) Requisite precautionary measures against fire, denting, breakage or loss must be ensured while the articles are in transit and till supply is completed.

f) Polishing and painting, as the case may be shall be done at site on receiving approval of the Consultant. The working area shall be cleaned properly before starting finishing work and subsequently before each day's work to ensure reasonably dust- free surrounding,

g) Particulars of the Workshop, working area, and storage space must be supplied to the Consultant, which will be checked by them and if required modifications will be made as instructed by the Consultant to ensure proper atmosphere and amenities.

h) In case of inflicting injury to any part of the building/ other works while installing the Bidder shall rectify the same employing proper men of the trade involved and materials required at his own cost.

i) The Bidder shall keep the Employer indemnified against all charges which may arise out of this Contract in case of procurement of timbers from local sources.

13.3 TIMBER

a) Timber only as specified in the drawing or schedule shall be used

b) Timbers shall be free from all defects such as sap, shakes, knots, upsets, wane edge, twisted fiber. It shall also be free from all diseases such as decay, druxiners, wet rot, dry rot, wood worms and white ant.

c) It shall be well seasoned containing not more than 8% to 12% moisture so as to ensure minimum tendency towards washed, shrinking and swellings.

d) It shall be relatively hard so that it does not get easily destroyed and exposed parts shall have good, bright and attractive grains in appearance.

e) Radial and tangential sawing shall be done as per instruction of the Consultant.

13.4 JOINERY

Joints shall be made according to sizes and profiles shown on the drawing.

a) No extra nails or screws, other than those used in approved samples, shall be used. Nails and screws to be used on finished surface shall be fitted slightly below the surface, Polyvinyl acetate adhesive of 'Aica Aibon' brand or other approved brand shall be used where use of adhesive is required or instructed.

Wooden pins, where required or instructed, shall be of the same species, perfectly round and pressure fitted in the holes which shall be circular.

b) All joints shall be of such true fit that they will not be discernible from a distance of 1.2m.

c) Layout of the joints shall be made by using accurate instruments. A knife can be used whenever a line is to be cut. A sharp pencil can be used for all layouts and especially when only part of the area is to be cut away. All measurements shall be made from a common starting point, edge or surface. All identical joints shall be laid out at the same time. Two members of each joints shall always be identified with a pencil mark for quick identification during assembling.

d) Right instrument or machine shall be used for each cut. The cuts shall always be made lust inside or outside the layout line, the joint shall be trimmed out with a router plane or chisel when necessary.

e) Proper kind of clamping devices shall be used for assembling the joint, a trial assembly shall be made to make sure that each joint fits properly, A correct method of fastening (such as glue, nails, screws, dowel, splices, etc.) shall have to be determined. The same shall be completely square and aligned when properly assembled.

13.5 GLUING UP

a) The stock shall be glued together where necessary. The glue shall be of 'Aica Aibon' brand Polyvinyl-acetate emulsion adhesive or its equivalent quality, the grain of all the pieces shall run in the same direction. The edge of gluing stock shall be of same maturity and strength.

b) A good glue must develop the full strength of the wood under all condition stress. To obtain this result it is necessary to control the gluing operation as well as the condition of the material, the moisture content before gluing shall not be too low or too high.

c) The average moisture content of wood is about 12% it is important that the wood parts being glued be at or near the same moisture content at the time of gluing in furniture making this is achieved by storing wood in a room where temperature and humidity are carefully controlled. lf moisture content is too high the glue

which penetrates the cell cavities will be thinned. On the other hand, if the moisture content is too low, the dry wood absorbs water from the glue, preventing an even spread and full penetration into the cavities. High quality glue joints cannot be made on Wet wood. The moisture content of timber shall be checked through each step of manufacturing preferably with an electrical moisture meter.

d) for proper gluing the Bidder shall check the following points:

i. Whether the parts of the assembly are at proper moisture content and temperature.

ii. Whether the gluing surfaces are smooth, free from irregularities, and even as possible.

iii. Whether all the joints have been placed under equal pressure.

iv. Whether the assembly has been under pressure long enough to allow the glue to dry properly.

v. Whether excess glue has been removed before machining.

13.6 PREPARATION OF WOOD SURFACE FOR FINISHING

a) After the joinery has been completed, there shall remain very important task of preparing it for applying varnish or paint. The process of preparing the surface includes the removing of all machine and plane marks and defects that will make an imperfect surface. Unless the surface is perfectly smooth and free from defects varnish shall not be applied.

b) The following rules shall be maintained-

i. Before assembling the work, all marks shall be removed from the visible parts with a plane or cabinet scraper.

ii. All traces of glue from around the joints shall be removed

iii. Defects, such as cracks and holes that cannot be removed shall be filled with stick shellac or its equivalent.

iv. After the shellac or its equivalent hardens, it shall be placed down until it is nearly leveled with the adjoining surface.

c) Then the surface shall be scraped and sanded thoroughly. Emery paper shall be used as abrasive. Four grades of abrasive paper shall be used successively in Order of No.2, No.1,No.0 and No.00. Sanding shall be done with grain. When thoroughly sanded, the dust shall be brushed off with a stiff brush and inspected to see if the surfaces are free from blemishes. Then it shall be rubbed with clean woolen rag.

d) At this stage and before application of varnish or painting all articles shall receive inspection and approval of the Consultant.

13.7 WOOD FINISHING

13.7.1 Type of Finish

Unless otherwise specified wooden surfaces shall receive clear shellac varnish.

13.7.2 Finishing Materials

a) Fillers shall be White Zinc or natural paste fillers.

b) Sealers shall be of shellac wash coat. This is mixture of seven parts alcohol to one-part shellac, using a Two-pound-Cut shellac. A two-pound-cut shellac means that there are four pounds of shellac mixed to a gallon of alcohol.

c) Finish shall be done with a mixture of equal amount of alcohol and Four-Pound Cut shellac.

d) Benzine shall be used as a cleaning fluid'.

13.7.3 Application

a) Fillers made in the form of heavy paste by adding desired amount of turpentine shall be applied with a stiff brush, brushing first with the grain and then across it, covering only a small area at a time. It shall be allowed to dry for a few minutes until it loses its glossy appearance. Excess fillers shall be wiped off across the grain with rough cloth. The surface then shall be rubbed with the grain lightly with soft cloth to remove the excess. lt should be pressed in such hardness so that the filler is not wiped off the pores. Finishing shall be applied only after the filler has dried.

b) Clean shellac varnish shall be applied with a good quality brush, 38mm to 75mm wide, starting near the center and top of a vertical surface or the middle of a horizontal surface, quickly brushing out in long, sweeping strokes without going

over the same area several times as shellac dries out very rapidly. Brushing should be done towards the edges and care should be taken not to allow the shellac to run over the edges and pile up. It shall then be allowed to dry for 3 to 4 hours, the surfaces shall be lightly sanded with No.00 dry abrasive paper along the grain. Grit and dust shall be removed with soft cloth before applying second coat with slightly reduced alcohol mixture. It shall then be allowed to dry and sanded lightly with No.00 dry abrasive paper along the grain. Grit and dust shall be removed again before applying the third coat with 25 percent alcohol mixture. After the last coat dries, the surface shall be wiped out lightly with benzine.

13.7.4 Gloss Enamel Finish

a) Gloss enamel finish on wooden surfaces shall be applied where it is explicitly specified in drawing on finished schedule.

b) Fillers shall be applied as specified and when it is dry, gloss enamel paint shall be applied in two coats, allowing first coat to dry and sanding with No.00 abrasive paper lightly.

c) It shall be applied with brushes under adequate illumination spreading evenly with smooth flow leaving no run or sag.

d) Paint shall be applied in strict conformity with the Manufacture/s instructions and in particular, no ready mixed paint shall be thinned in any way excepts directed by the Manufacturer. It shall be thoroughly mixed before being used.

13.7.5 Preparation of Samples

a) Before starting full scale finishing work, sample- finishing shall be done on similar wooden surfaces, 300mm x 300mm, and shall receive approval of the Consultant.

b) Modifications, if required, in the above specifications shall be done depending on the outcome of sample work.

c) No payment will be made unless samples are made before hand and approval of the Consultant is received for the same.

13.8 FINISH HARDWARES AND ACCESSORIES

13.8.1 Materials and Finish

a) All materials and finish shall be as approved by the Consultant.

b) All Hardware and Accessories while purchased, shall be in the Manufacture/s Original Packages complete with all required trimmings.

c) All materials and finish shall conform to the sample approved by the Consultant and no substitution shall be made without the approval of the Consultant.

d) Two sets of complete list indicating the Manufacturer's Name, Brand, Name, Type, size and location of all hardware to be installed shall be submitted to the Consultant for his approval. No hardware shall be ordered until this list has been approved by the Consultant.

13.8.2 Samples

Before ordering materials, the Bidders shall submit to the Engineer /PITfor his approval a complete list of samples in duplicate making Manufacture’s numbers, types and sizes. Samples shall remain, with the Consultant until procurement of all hard wares are complete, approved by the Consultant and incorporated in the work.

13.8.3 Fastenings

All hardware and accessories as shown in drawing or schedule of work or as ordered in writing by the Consultant shall be supplied with the best stainless and non-corrodible variety of screws, bolts, nuts and other fastenings and approved by the Consultant for attaching them, these shall be of the same finish as the material which they attach and shall be of type and standard of the Manufacturer'.

13.8.4 Butts and Hinges

a) Butts and Hinges shall be non-corrodible variety and approved by the Consultant.

b) The sizes and numbers shall be as per drawing.

c) Lock Sets: All lock sets shall be of the Yale type door lock of the best quality if not shown in drawing or mentioned elsewhere.

d) Strikes shall be used where required to protect trim from being maned by hatch bolt

e) All keying shall be done by the Lock Manufacturer and two keys per lock shall be supplied with proper identification'

f) Installation: All items of finish hardwires and accessories shall be carefully fitted and adjusted to ensure smooth operation.

g) All items of finish hardwires and accessories shall be in perfect operating condition and undamaged while installing.

13.9 INSTALLATION

a) Door or window frames shall be installed by using GP sheet hold fast as shown in drawing after the masonry has hardened sufficiently. The surface of timber in contact with masonry shall be painted with two coats of far (mixed with kerosene and lime)

b) Door and window shutters shall be installed with approved hard wares and accessories as shown in drawing and specifications.

c) Dunnage: Dunnage shall be manufactured as per drawing with well-seasoned (8% moisture) Garzon or any other local hard wood like Shill, Babla or Sundori timber or approved by the Consultant, the surface of the timber shall be wrought finished, painted with two coats of approved tar paint. The nails to be used shall be approved by the Consultant

13.10 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 14 LIME CONCRETE ROOFING

14.1 SCOPE OF WORK

The work to be performed under the Section shall consist of making water proofing and drainage course on roof slab by using lime concrete 2:2:7 as specified here under and as per drawing.

14.2 MATERIALS

a) Lime concrete shall be mixed using lime, surki and brick aggregate as herein specified.

b) Lime shall not contain more than 5% of foreign impurities. It shall dissolve in soft water when this is added in sufficient quantities. Stone lime from Sylhet meeting the above requirement may be used. Lime shall first be slaked for 48 hours, then strained through a sieve of 64 meshes to the square meter.

c) Surki shall be made only from well burnt but not vitrified brick bats of Class one. Surki made from under-burnt bricks shall not be used. Surki shall be perfectly clean, free from admixture of dust, sand or any other particles and shall be ground to such fineness as would pass a sieve of 64 meshes to the square meter.

d) Brick aggregate shall be from well burnt but not vitrified bricks and shall be below 25mm size. Brick aggregate shall be continuously soaked for 2 days before use,

14.3 MIXING

a) The approximate proportions of the mixture shall be 2 parts lime to 2 parts surki to 7 parts brick aggregate, both made from first class bricks. The lime and surki shall be mixed dry and laid on top of stack of brick aggregate. While mixing small quantities of water shall be added as required. Once the materials are mixed the mixture shall be left to temper itself for 24 hours after which it will be remixed by spading followed by another spading after 24 hours. The procedure shall be repeated till the mixture is ready for laying.

b) The mixing shall be done invariably on the ground on a brick platform at the designated place.

14.4 INSTALLATION

a) The roof deck on which the mixture will be laid shall be cleaned and washed accompanied by scrubbing if necessary. The mixture shall be laid 25mrn more than the beaten thickness according to the grades and slopes as shown is the drawing. Before beating commences, grouting of lime shall be sprinkled on the surface and allowed to soak well. Beating shall be done by two rows of workers sitting in a row who will traverse the length of the roof backwards and forwards beating with wooden mallets. Beating shall continue until the mixture has almost set and the mallets rebound from the surface. Beating shall usually be continued for 5 or 6 days. Lime water to which molasses are added @0.22 kg. To a.005 cum. shall be sprinkled at intervals to keep the lime concrete wet while being beaten. The surface shall never be allowed to dry, no plaster shall be given to the surface.

b) Where lime concrete roofing cannot be placed all in one day, each day's work shall be terminated on a straight line with 1:2 slope, joining of new work to previous day's work shall be accomplished by applying a bonding paste of lime surki mortar 1:1 to the slope before placing the new lime concrete.

c) Turn-up along parapet shall be provided as shown in drawing and finished in a manner similar to decks.

d) The surface shall be brought lo a very fine polish by rubbing with a fine small trowel and to assist this fine lime putty may be used sparingly

e) Next the work shall be cured for 2 weeks by covering with a 50mm layer of moist earth mixed with 3% straw or hay. This layer shall be moistened from time to time as required, at completion of the curing period the layer of earth shall be removed and the entire roof area swept clean. Good care shall be taken not to clog roof drains.

14.5 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 15 ROOF FINISHING AND SCREEDING

15.1 SCOPE OF WORK

The work to be performed under this Section shall consist of making water proofing and drainage course on roof slab by using C.C. (1:2:4) and specified hereunder and as per drawing

15.2 MATERIALS

a) Roof finishing by C.C. using stone chips (12mm downgraded), course sand and cement with thickness specified in the drawing.

b) Stone chips should acquire abrasion value not less than 30 and course sand should have F.M. 2.5 (min.)

c) Cement: Characteristics of cement will be as per specified in specification of Concrete work.

15.3 MIXING

a) The approximate proportion of mixture shall be 1 part cement, 2 part course sand and 4 parts stone chips.

b) Stone chips should acquire abrasion value not less than 30 and course sand should have F.M. 2.5 (min.)

c) Cement: Characteristics of cement will be as per specified in specification of Concrete work.

15.4 LAYING

a) The surface where to be poured should cleaned, and cured.

b) Slope to be maintained as specified in the drawings,

c) Surface to be finished by steel trowel using cement slurry simultaneously without adding any sand.

15.5 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the

contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 16 GLASS AND GLAZING - PARTITION WALL AND OTHER PLACES

16.1 GLASS

a) All glass shall be sheet glass unless otherwise specified of approved quality and shall be of the various sizes and thickness as shown in drawing,

b) All glass shall be free from bubbles, distortion and flaws of every kind and shall be colorless if not mentioned otherwise,

c) Each place of glass shall bear a label indicating the name of manufacturer the thickness and type of glass' Label shall remain on glass until final cleaning.

d) Glass with framing should be able to withstand the design wind pressure.

16.2 SAMPLES

Samples of each type of glass, size 75mm by 100mm bearing the name of the manufacturer, thickness' type of glass shall be submitted to the Consultant for approval.

16.3 GLAZING, GENERAL REQUIREMENTS

a) All glazing work shall be performed in accordance with the typical glazing details shown on drawings.

b) Joints and spaces to be sealed shall be thoroughly dried and made free from dust and other foreign materials before glazing.

c) All glass shall be set with proper clearance as recommended by the manufacturer at all edges, Glass with nipped or damaged edges shall not be installed.

d) Adjacent materials which are solid shall be cleaned immediately before the sealant and compound harden or stain the adjoining surfaces.

16.4 GLAZING OF WOOD AND METAL WINDOWS

a) First a thin layer of sealant made of chalk, double boiled lin-seed oil and resin is to be applied to the frame surface to come in contact with glass.

b) Then the glass will be set taking care to centre with equal clearance of jambs between glass and frame.

c) The glass is next be pressed firmly into place against sealant.

d) A bead of sealant is then to be laid into space between glass and frame, then sufficient sealant will be applied so that when top is put in place the sealant will be forced between glass and stop, and completely fill the space between frame, glass and stop.

e) The removal stop is then to be installed.

f) The remaining space between the face of glass and stop shall be completely filled with sealant.

16.5 MIRROR

Mirrors shall be 6mm thick conforming to ASTM C1503-08 Standard. Mirrors shall be cut to size and framed. Color shall be “Clear Glass Mirrors.” Quality shall be “Mirror Select Quality.” They shall have a silver coating hermetically sealed with uniform coating of electrolytic copper plating and the copper protected by a coat of mineral oxide, oil base paint. Mirrors shall be fixed in position in accordance with Architectural detailing.

16.6 DEFECTS AND BREAKAGE

a) The Bidder shall replace all glass which does not comply with these specifications or having defects not permitted by the manufacture/s grading rules.

b) The Bidder shall replace all glass which is broken, cracked or chipped by his own men or due to faulty installation,

c) The Bidder shall replace all glass broken, cracked or chipped by any other cause, so that all glass is in perfect condition at the time of acceptance of the building.

16.7 CLEANING

No glazing shall be considered complete until and unless paints and other stains have been removed from the surface of the glass and its frame if any. Glass must be cleaned and polished with pads of damp cloth and then with clean dry soft cloths. It will have to be finally finished with appropriate glass cleaning fluid and made absolutely free of foreign materials.

16.8 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on

measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 17 ALUMINIUM FRAMED DOORS AND WINDOWS

17.1 SCOPE OF WORK

The work under this item shall consist of supplying and fixing aluminum framed products of various types such as aluminum framed glass doors, windows, curtain walls, curtain rail, cladding etc, fitted with necessary hardware and finished in accordance with applicable drawing and specifications.

17.2 DOOR AND WINDOW FRAMING AND CONSTRUCTION

a) Extruded Sections for doors, windows, screens and fixed panels shall be of high quality 6063-T5 latest modified aluminum alloy, minimum 1.8mm to 2mm thick and of required depth for interior works.

b) Aluminum frames holding exterior glass panels shall be designed to withstand high wind pressure resulting from the basic wind speed of 74 m/s (3-sec gust). Calculation of wind pressure for design of the aluminum panels shall be on the basis of BNBC 2020. For aluminum frames holding glasses on exterior facades, the metal thickness of the aluminum shall be minimum 3.0 mm. Overall thickness of such aluminum frame section shall preferable not be less than 38mm and the width shall preferably not be less than 75mm.

c) Aluminum facings/skins (both sides for light cored flush doors shall be of 5005-H 14 latest modified aluminum alloy, power coated or anodizing quality and monolithic sheet approved by the EIC.

d) Aluminum Sections and facings shall be power coated/anodized with an anodic film of 18 microns, minimum, to ensure resistance to abrasion and environmental attack. The colour spectrum will be Dark Bronze of approved tone.

e) Over all thickness of flush door panels shall be 44mm and suitable for use in commercial type buildings.

f) Head, sill and jamb members shall be of one piece construction.

g) All joints shall be mechanically done square (telescopic)joints and bedded in a poly-sulphide sealant. No mitred joints will be accepted, no forced fitting will be accepted.

h) Components, parts and accessories shall be of aluminum alloy, stainless steel or man-metallic materials which will neither deteriorate nor promote corrosion and shall match with frames,

i) Aluminum to aluminum contact between hardware parts or door/window members that move against one another shall not be permitted.

17.3 HARDWARES

a) Rollers shall be long wearing nylon with stainless steel ball bearings encased in non-corrosive extruded aluminum housing concealed in frames of sliding sash.

b) Window locks shall be flush type as manufactured by the Adams Rite Manufacturing Company of Glendale, California or an approved equivalent. It shall be spring loaded to provide automatic locking in closed position.

c) Security locks shall be pin type mortise lock, having 6 or 7 pins and adaptable for Master, Grand Master and Great Grand Master Keys.

d) Closures, Push/Pull and Kick plates shall have to match with the frames, any other hardware to be incorporated in the work must also match with the frame.

e) Assembly and installation Screws shall be stainless steel. Doors and windows shall be installed in the building with Teflon injected expanding bolts.

17.4 FITTING

All glass shall be fitted in the frames with butyl based non- setting glazing mastic channel of required sizes.

17.5 WEATHER STRIPPING

a) Polypropylene/ virgin vinyl weather stripping shall be integrated with all extrusions to avoid metal to metal contact and give full protection against droughts and from buffeting.

b) Stiles of all movable sashes shall be provided with wool pile fabric weather stripping on both interior and exterior faces to properly contact main frame.

17.6 SEALANTS

Contact faces between Aluminium frames and structural members shall be sealed with sealants like DynasealW.100/Sikaflex Construction Sealants or approved equal.

17.7 GLASS

a) Base glasses for all glazing work shall be Float Plate glass whether keys are clear, tinted or reflective glazing.

b) Door panels along with adjoining fixed panels either in sides or above shall be minimum 6mm thick tempered clear glass fixed with 0.3mm thick frosted film.

c) Reflective/Tinted glass shall match Dark Bronze spectrum (ANOLOK-516/CORE Alloy Medium Bronze or equal).

d) Minimum thickness for window glass panels either fixed or sliding shall be of minimum 5mm thick bronze tinted glass. Glass in curtain walls shall be of 6mm thick tempered bronze tinted glass. However, the different thickness of glass to be used as per manufacturers' specification.

e) Exterior glass panels shall be designed to withstand high wind pressure resulting from the design wind speed of 74 m/s (3-sec gust). Calculation of wind pressure for design of the aluminum panels shall be on the basis of BNBC 2020. Such glass panels shall preferably be laminated tempered i.e. 5mm.+5mm.glass with 3 mm. thick PVB lamination.

17.8 METHOD OF MEASUREMENTS

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 18 FINISHED HARDWARE AND ACCESSORIES

18.1 GENERAL REQUIREMENTS

a) The work under this Section consists of furnishing and delivering to the site all finished hardware and accessories required in accordance with the drawing to be fitted in doors' windows and other items.

b) All hard wares shall be delivered in the manufacture’s original packages' complete with all required fastenings and trimmings.

c) All hardware shall conform to the requirements specified hereinafter No substitutions shall be made for the sample submitted without the approval of the Consultant /PIT.

d) Required templates shall be submitted for proper installation.

18.2 SAMPLE

Before material is ordered, the bidder shall submit in duplicate to the Consultant for his approval a complete list of samples along with to set, of schedule as specified hereinafter sample shall be plainly marked giving the manufacturers number, types and size sample will remain with the Consultant until delivery of all hard wares to the project site is complete, then they shall be used in the work.

18.3 SCHEDULES

Two sets of complete lists of ail hard wares to be furnished under this Section shall be submitted to the Consultant for approval. The list shall indicate the manufacturers name and hardware designation, type size and installation location. Hardware shall not be ordered until the list has been approved.

18.4 FINISH AND MATERIALS

All finish and material shall be approved by the Consultant /PIT.

18.5 FASTENINGS

All hardware shall be non-rusting, non-corrodible and supplied with screws, bolts, nuts and other fastenings for attaching hardware. These shall be of the same as the material which they attach and shall be of types' standard of the manufacturer.

18.6 RECEIVING AND STORING

The bidder shall provide adequate rocked up storage space, Lost or damaged hardware’s shall be replaced at no cost to the Engineer/PIT.

18.7 BUTTS AND HINGES

a) Windows and other works unless otherwise specified in the schedule of items of work.

b) The sizes and numbers of the butts and hinges shat be as detailed in the drawings or approved by the Engineer/PIT.

CHAPTER 19 PLASTERING AND POINTING

19.1 SCOPE OF WORK

The work to be performed under the Section includes cement plaster on brick or concrete surfaces for protection and appearance as shown and noted on the drawings and as specified.

19.2 DESCRIPTION OF WORK

19.2.1 Plastering

a) Plastering shall be performed in a neat, true and workmanlike manner. Corners shall not be rounded or beveled unless directed by the Engineer. All inter Sections, edges and corners shall have sharp edges, unless otherwise directed, and shall be at right angles. Lines shall be straight and true.

b) Unless specified otherwise, cement plaster shall be used in the following proportion. On brick walls, one part Portland cement to six parts sand; on concrete surfaces, one part Portland cement to four parts sand by weight or by volume, but either method requires approval of the Consultant.

c) Before starting plaster work, brick joints shall be raked out to a depth of 6mm and concrete surfaces shall be roughened. Both brick and concrete surfaces shall be cleaned to remove loose materials and shall be thoroughly dampened with water.

d) Thickness of cement plaster for brick surfaces will be min 12mm and that for R.C.C. surface will be min 6mm' the F.M of Sand will be 1.50 unless otherwise specified. Mortar shall be mixed in such quantities as can be used in work within30 minutes after mixing with water. Mortar which has taken initial set shall not be used and such mortar shall be discarded. water cement ratio for mortars mix shall not be more than 0.5.

e) All plaster shall be kept moist throughout the progress of the work and for at least 10 days thereafter. If cracks or blemishes appear-through negligence or due to other reasons the defects shall be rectified by the bidder at his own expense.

f) Plaster shall be floated and toweled to a true and plumb surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless sits size is over 300 square feet and prior permission is received from the Consultant. Plaster shall be stopped only at corners, sieves, construction or expansion joints.

19.2.2 Pointing

a) Unless otherwise specified, the proportion of cement mortar shall be one part of Portland cement to three parts of sand of fineness modulus 1.5 and lime in powder form passing 100 mesh in proportion 25% by weight of cement.

b) All joints to be pointed shall be scrubbed, roughened, cleaned and dampened with water. Mortar of specified proportion shall be applied at the joints and finished in Ruled or concave Pointing or as indicated or directed by the Consultant

c) The surface and edge of exposed bricks in brick work shall be kept clear of mortar stains.

d) The pointed surface shall be kept moist during the progress of the work for at least 10 days thereafter.

19.3 METHOD OF MEASUREMENTS

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 20 ARTIFICIAL PATENT STONE FLOORING

20.1 ARTIFICIAL PATENT STONE FLOORING

Scope of work: the work consists of installation of finishing layer of cement concrete work over concrete floors or anywhere in panels for leveling and small finishing of the top surface of the floor.

a) Materials shall be as follows

   i. Cement: As defined in Chapter 5.

   ii. Sand: Clean, twice washed river sand. Minimum fineness modulus (FM) not less than 2.50.

   iii. Coarse Aggregate: Clean, twice washed 12mm down broken Stone/ Aggregate Pea Gravel as specified in the Schedule of item of Works.

b) Before proceeding with the work a sample panel of artificial patent stone flooring shall be prepared as specified for approval of the Consultant /PIT.

c) Sub-floors over which the artificial stone flooring will be laid shall be thoroughly picked and washed clean and laitance, dust, dirt and other foreign matter to the satisfaction of the Consultant /PIT.

d) Following the preparatory work, the slabs shall be thoroughly wetted with clean water by ponding at least overnight prior to the application of the floorings. All excess water shall be removed ahead of the application of the bonding slurry so that the concrete surface is uniformly damp but not glistening wet.

e) A creamy bonding slurry of neat cement shall be supplied and well scrubbed into the surface with stiff bristle brushes. Only as much bonding slurry shall be mixed and applied as will be covered by the succeeding coat before the slurry dries out.

f) In general not over 10.20 sqm, shall be slurried at one time in order to maintain a "Live GIue" for bonding. The slurry shall be applied by brush in small areas not exceeding 1.5 square meter, Excess or dead slurry shall be constantly removed from the base by brown.

g) Concrete mixed as in Chapter 5 and in a specified proportion shall be applied promptly in specified thickness after slurrying and before the paste has hardened or dried.

h) The method of measuring materials shall be such that the specified proportion of the materials can be controlled and accurately maintained. Shovel measurements will not be allowed. All constituents shall be thoroughly mixed. No reappeared materials and no materials which has partially set shall be used in the work.

i) The mixture shall be thoroughly tamped by hand. The compaction shall be followed by steel troweling (after the excess water has dried surface is still damp but not glistening wet) to bring the finish to a smooth, hard surface free from marks and imperfections of any kind. Dusting with dry cement or sprinkling with water will not be permitted in finishing. Finished surface must be kept clear of dust, dirt or clay stains and shall be of uniform color all over.

j) The temporary dividers may be of metal strips or wooden battens of true line and shape. The top of the dividers shall be perfectly levelled with level of the finished floor desired,

k) The sequence of filling in the panels shall be on "Checker Board" plan. The casting of the complementary set shall be done at least 48 hours after the first set is cast and dividers removed.

l) The top shall be mist cured for at least 7 days. The flooring shall not be subjected to moderate use before 14 days and to severe use before 28 days.

20.2 INSTALLATION

Patent stone floor finish shall be made at places and location as shown in drawing or in Finish Schedule.

20.3 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras,

wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 21 FALSE CEILING

21.1 SCOPE OF WORK

This work covers all operations in connection with installation of ceiling panels as shown and noted on drawings and specified herein.

21.2 SAMPLES

Bidder shall furnish at least 3 full size samples of ceiling panels (including suspension systems) proposed for use to the Consultant for approval.

21.3 SHOP DRAWINGS

Shop drawings shall be prepared showing all pertinent information for ceiling panels including size, location, and suspension systems. Installation shall proceed in accordance with approved shop drawings.

21.4 MATERIALS

a) Ceiling Panels: Viny-faced, glass reinforced Acoustic Mineral Board/ Gypsum board lay-in panels shall be used for ceiling. Size of the panels shall be as shown in the drawings. Thickness of vinyl finish shall not be less than 2 mm.

b) Suspension systems: Grid and framing shall be galvanized steel of gauge noted in drawing and shall be finished on the exposed surfaces with an anodized aluminum coating. Grid and framing system shall comply with ASTM C635,"standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

21.5 INSTALLATION AND WORKMANSHIP

a) All ends and edges of all acoustic mineral board panels shall be positioned, over framing members and shall be attached to framing supports by adhesive application, Adhesive used shall be rubber-based construction adhesive meeting ASTM C557,

b) Cutting of ends and edges, and making cutouts within field of panels shall be done in a worksman like manner.

c) All internal and external angles formed by the intersection of either panel surfaces or other surfaces shall be installed trim, Corner bead to all external corners shall be applied in accordance with the manufacturer's instructions.

d) All studs, runners and other accessories shall be installed in accordance with the manufacture/s instructions. The studs and runners shall be spaced 24" C.C.

21.6 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 22 CERAMIC TILES AND HOMOGENOUS FLOOR TILES WORKS

22.1 SCOPE OF WORK

The work to be performed under the provision of this section includes furnishing and installing of all glazed/ minor polished and non-skid ceramic tiles work as shown and noted on the drawings and as specified herein.

22.2 SAMPLES

Bidder shall furnish at least 3 full-size samples of ceramic tiles proposed for use to the Consultant for approval.

22.3 MATERIAL

a) Tiles shall be approved size and color. lt is to be cut to required sizes and finishes where enquired it shall be approved by the Consultant, Tiles will be free from any type of absorption. Thickness and strength will be as per manufacturer's specifications.

b) Cement: Cement shall be as specified in specification for concrete work,

c) Fine Aggregate: Fine aggregate shall be as specified in the specification for concrete work. The fineness modulus of sand shall not be less than 1.00

d) Water: Water shall be as specified in the specification for concrete work.

e) Adhesive: High strength latex admixture for mortar shall be used with cement in proportion as recommended bi manufacturing making mortar bed. The admixture shall have a bond strength of min, 3.5 MPa in 72 hours and a min. compressive strength of 35MPa.

22.4 MORTAR

a) Cement mortar shall consist of a mixture of one part by weight or volume of cement to two parts by weight or volume of fine aggregate and required adhesive. The method of mixing mortar, either by weight or volume, requires approval of the Consultant /PIT.

b) The cement, sand and required adhesive shall be mixed dry in the specified proportions until the color of the mixture is uniform. Approved water shall then be added sparingly, only the minimum necessary being used to produce a workable mixture of normal consistency. The water/cement ratio shall not exceed 0.50 by weight unless directed otherwise by the Consultant /PIT..

c) All mortar shall be machine mixed.

d) Mortar shall be mixed in such quantities as can be used in the work within 30 minutes after mixing with water. Mortar which has taken initial set shall not be used nor shall it be remixed with fresh mortar, and such mortar shall be discarded Ceramic tiles work.

22.5 INSTALLATION AND WORKMANSHIP

a) Tiles work shall be done to dimensions and pattern indicated on the drawings, plumb, and leveled as required, by skilled masons and workmen properly supervised. Tiles shall be thoroughly washed and soaked in water for at least 4 hours before use.

b) Joints in tiles works shall be maximum 0,78mm or as specified and shall be finished with white cement pointing works, neatly made so as not to stain the surface of the tiles.

c) Tiles work shall be cured for minimum 10 days.

22.6 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 23 PAINTING

23.1 MATERIALS

The item covers application of approved paints over surfaces (masonry, wood and steel) in min 3coats or as specified by manufactures in a manner to guide an even, smooth finish of confirm shade will at any mark of brush and joint.

Interior walls of office building shall have acrylic plastic emulsion paint finish. The painting work shall include proper cleaning and preparation of the surface, application of sealant, application of putty, and smoothening of the surface using find grained sand paper and application of two coats of acrylic emulsion paint. Painting of the ceiling shall follow similar procedure but only one coat of acrylic emulsion paint to be applied.

a) Before purchasing materials, the Bidder shall submit to the Consultant a list showing the brand and type of paints proposed for the Work indicating items receiving different kind of paint. Manufacturer's catalogue, date or specifications, in triplicate for materials selected shall be submitted to the Consultant with the list of brands and types. No materials shall be used without approval of the Consultant /PIT.

b) All painting materials shall be of the best quality and be delivered to the site in unopened original containers bearing manufacturer’s labels.

c) Materials to be used in the work shall conform to reputed Manufacture/s specifications and to the satisfaction of the Consultant /PIT.

23.2 STORAGE OF MATERIALS

a) Materials and tools shall be stored in a single place at the site as designated by the Consultant /PIT.

b) Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.

c) Inflammable materials shall be stored in sealed containers, waste shall be removed from the premises at the end of each day, every precaution shall be taken to prevent fire.

d) Storage area shall be accessible to the Consultant /PIT at all times.

23.3 COLOURS AND SAMPLES

a) Color scheme shall be as shown in the Finish Schedule and directed by the Consultant and all tinting and matching shall be to the satisfaction of the Consultant /PIT.

b) For all natural or painted wood finishes, samples shall be prepared as directed on pieces of the same kind of wood at least 150mm by 300mm until the finish is approved.

c) For painted finish on masonry or concrete surfaces, samples shall be prepared as directed on the surface to be painted until the finish is approved.

23.4 PROTECTION

Drop cloths or other approved protection materials shall be furnished and laid in all areas where painting and finishing is being done so as to adequately protect flooring and other work from all damage during the execution of the painting work.

23.5 SURFACE PREPARATION

23.5.1 Plastered Concrete and Masonry Surface.

All surface to be painted shall be thoroughly cleaned of all grit, grease, dirt, loose materials, mortar drippings and the like.

23.5.2 Wood to be Cleared of Old Stains Or Paints

a) It shall be sanded smooth and made free of marks before applying the first coat.

b) Voids and holes shall be filled after first coat is dry using filler compatible with the finishing specified and tinted if required to camouflage repairs.

23.5.3 Ferrous Metal

a) It shall be wire brushed or sanded to remove all rust, dirt, weld spatter and other foreign matter.

b) Grease and oil films shall be removed with a solvent, using a fine steel wood pad or a coarse cloth.

c) All damage to shop coat caused by erection, repairing and cleaning Shall be spot primed with the same materials used for the shop coat.

23.5.4 Galvanized Metal

Galvanized metal shall be clean and dry. Grease and oil films shall be removed with a solvent, using a fine steel wood pad or a coarse cloth, instructions of primer manufacturer are to be followed.

23.6 APPLICATION

a) No work shall be done under conditions which are unsuitable for the production of good results. All spaces shall be boomed clean before painting or finishing is started.

b) The workmanship shall be the best. All paint shall be applied with brushes/ rollers under adequate illumination, evenly spread, smoothly flowed on without runs or sags, Paint shall be worked into all corners and crevices.

c) Materials shall be applied in strict accordance with the manufacturers directions, and in particular, no prepared paint shall be thinned in any way except as directed by manufacturer. All paint shall be thoroughly mixed before being used.

d) Each coat applied must be inspected and approved by the Consultant before the application of the succeeding coat. Otherwise no credit for the coat applied will be given and the Bidder may have to repeat the work in question at his own expense. The Bidder shall notify the Consultant when each coat is ready for inspection.

e) No exterior painting shall be done in rainy, damp weather until the surface is thoroughly dry. No interior painting will be done on damp surfaces.

f) Minimum drying time shall not be less than 72 hours between coats for exterior paints and 48 hours for interior coat paints. Each coat shall be thoroughly dry before application of subsequent coat.

g) All-natural finished woodwork, painted woodwork and painted metal shall be slightly sanded between coats using No.00 sand paper. The finished surface must be smooth, evenly level and free of brush marks.

h) Natural finished wood work only shall be rubbed with fine sand paper after last coat to desired finish as per approved sample.

i) All woodwork for natural finish shall be sealed on the back and all surfaces which will be concealed after erection with two coats of an approved transparent sealer prior to installation.

j) After being fitted by the Carpenter, all edges of doors shall be finished same as the faces.

k) Suction spots in plaster, masonry or concrete showing after application of first coat shall be repainted before application of next coat.

l) All exposed piping (except P.V.C) if specified, shall be painted to match the adjoining wall surface where such wall surface is either glazed tile or painted.

m) Painting around Finish Hardware of other removable items already in place will not be allowed.

n) Any damage to adjacent work caused by paint or painting operations shall be rectified by the Bidder at his own expense.

23.7 COMPLETION

a) At completion of painting work, the Bidder shall remove any paint spots and stains caused by work under this Section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

b) The Consultant will conduct a final inspection of all work under this Section and the Bidder shall repaint or retouches directed by the Consultant any surfaces which do not comply with the requirements of these specifications or which have been damaged during construction work. All surfaces finished under this Section shall be left in perfect condition free of defects and blemishes.

c) All rubbish and accumulated painting materials shall be removed from the premises.

23.8 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made

either for any demolished parts or for reconstruction, substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 24 NEAT CEMENT SKIRTING/DADO

24.1 SCOPE OF WORK

This item shall consist of providing 12mm thick neat cement finished skirting/dado on a 1:4 cement-sand mortar under bed on walls or where necessary in accordance with these Specifications.

24.2 GENERAL

Materials shall meet requirements as stated in Masonry work.

a) Wall plaster, if any, shall be removed along the floor to the required height and the surface shall be thoroughly scrubbed and wetted before applying the under bed. The second undercoat shall have a nominal thickness of 6mm and the total built-up thickness will be same as that of the plaster on the wall. A 3.0mm-deep grove shall be formed where skirting/Dado meets wall plaster.

b) The skirting/Dado shall be installed flush with the finished wall surface. The intersection with the floor shall be at right angle and the top of the skirting/Dado shall be straight and sharp.

c) The under bed shall be laid as uniformly as possible and allowed to become firm before scratching for key and subsequently allowed to become thoroughly dry before applying the second undercoat. A neat cement paste 3mm thick shall be spread evenly over the second coat and shall be steel trowelled under firm pressure to produce a dense uniform smooth surface free from trowel marks.

d) The work shall be cured and protected from weather, for at least 10 days immediately following the installation.

24.3 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or

other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 25 WEATHER COAT CEMENT BASED PAINT

25.1 SCOPE OF WORK

The work covered under this item shall consist of applying min 3 coats of weather coat cement based paint of approved colour over a coat of priming on exposed brick or concrete surfaces and cement render on wall, ceiling and elsewhere in accordance with these specifications.

25.2 DESCRIPTION OF WORK

a) Weather coat cement based paint shall be of Berger origin of approved colour. The application of Snowcem shall strictly comply w1h the manufacturer's instruction. The application shall preferably be canied out after a period of dry weather and before application, the surface shall be thoroughly cleaned, wetted and made dry if required' the wash shall be prepared by mixing and stirring, Snowcem powder, sand/lime as per manufacture's specifications and water in such quantities as will produce a mixture of the consistency of thin cream. When sufficiently mixed, the mixture shall be strained through a clean coarse cloth.

b) The surface to be Snowcem washed shall be thoroughly cleaned of all foreign matter by a use of stiff wire brush, sandpapering or other approved means. Weather coat cement based paint shall be applied in min. 3 coats alternately laid on vertically and horizontally on prime coat. Each coat shall be perfectly dry before the succeeding one is laid over it. The paint shall be applied on using good hair brush/ cotton roller and not with brushes made of jute. Proper curing for at least 7 days to be done.

25.3 METHOD OF MEASUREMENT

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction, substitution, extension or

other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 26 MATERIAL TESTING

26.1 GENERAL

Quality assessment and control shall be made through various kinds of testing conducted at site and at renowned laboratories like BRTC, BUET. Items to be tested, method and standards of testing etc. are described in details in the following sub-sections.

Sampling or preparation of test samples of all materials shall be done in presence of the Owner / Project Manager /Consultant or their authorized representatives. All samples shall be collected from project site and shall be duly sealed and signed by Owner / Project Manager /Consultant or their authorized representatives before sending to the laboratory. The test quantity mentioned in this section/chapter applies to each building and structure as appropriate.

26.2 REINFORCEMENT FOR CONCRETING WORKS

a) For a particular rebar diameter, one set of test samples constitute three rebar samples of length 1200mm each.

b) For each set of samples the following tests are to be performed – diameter, unit weight, yield strength, tensile strength, total elongation, bend test and measurement of deformations in accordance with the requirements of BDS ISO 6935-2:2021.

c) All rebar must meet the requirements of Grade B500DWR in accordance with BDS ISO 6935-2:2021.

d) Rebar testing instances and diameter of rebar to be tested shall be in accordance with the Table 26-1.

Table 26-1: Rebar testing instances and diameter

Sl	Description	No of test instances	Rebar dia. To be tested in each instance.
1	Pile	20	10mm, 16mm, 20mm
2	Slipway	10	16mm, 20mm, 25mm
3	Winch Control and Power	06	12mm, 16mm, 20mm, 25mm
4	Repair Facility	05	10mm, 12mm, 16mm, 20mm, 25mm
5	RC Pavement and drainage	06	8mm, 10mm, 12mm, 16mm, 20mm
6	Security, Pump and Blasting	04	12mm, 16mm, 20mm, 25mm

26.3 CEMENT FOR CONCRETING WORKS

a) All cements shall conform to standards BDS EN 197-1:2003, Type CEM-II or CEM-III, strength class 42.5 N.

b) One intact bag of cement shall be randomly collected from site for each instance and shall be sent to laboratory for testing.

c) Tests to be performed for each bag of sample shall be: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196 1, iii) Fineness by EN 196-6.

d) Cement testing instances shall be in accordance with the Table 26-2.

Table 26-2: Cement Test Instances

Sl	Description	No of test instances
1	Pile	12
2	Slipway	08
3	Winch Control and Power	08
4	Repair Facility	04
5	RC Pavement and drainage	06
6	Security, Pump and Blasting	02

26.4 COARSE AGGREGATE FOR CONCRETING

a) Coarse aggregate for concrete grading shall meet the requirements of ASTM C33/C33M-13 specification.

b) Los Angeles (Grading B) abrasion value shall not exceed 25% for aggregates used in structural concreting.

c) Tests to be performed for each instance of sampling i) Sieve analysis, ASTM C136-14 ii) L.A. abrasion test ASTM C131-14.

d) Aggregate testing instances shall be in accordance with the following

Table 26-3: coarse aggregate test instances

Sl	Description	No of test instances
1	Pile	10
2	Slipway	05
3	Winch Control and Power	04
4	Repair Facility	04
5	RC Pavement and drainage	04
6	Security, Pump and Blasting	02

26.5 FINE AGGREGATE (SAND) FOR CONCRETTING WORKS

a) Grading of fine aggregate for concreting shall meet the requirements of ASTM C33/C33M-13 specification. Fineness modulus of fine aggregate for structural concrete works shall not be less than 2.5.

b) Tests to be performed for each instance of sampling,Sieve analysis, ASTM C136-14.

c) For the sand used in the structural concrete, aggregate testing instances shall be in accordance with the following in Table 26-4.

Table 26-4: No of fine aggregate test instances

Sl	Description	No of test instances
1	Pile	10
2	Slipway	05
3	Winch Control and Power	04
4	Repair Facility	04
5	RC Pavement and drainage	04
6	Security, Pump and Blasting	02

26.6 CONCRETE CYLINDER

a) Concrete cylinders of size 100 mm dia. and 200 mm height shall be prepared at site at the time of concreting following appropriate procedure.

b) 09 (nine) cylinder samples shall be prepared at each instance for sampling. Samples shall be properly marked or labeled andcured at site. After 3-days of curing, six samples shall be sent to laboratory for testing and the remaining three samples shall be kept at site andproperly cured till 28 days. After 28 days, these sample shall be kept at site. From the samples sent to laboratory, three shall be tested at 7 days and the other three shall be tested at 28 days.

c) Compressive strength test shall be carried out in accordance with ASTM C-39.

d) Average 7-day strength shall not be less than 60% of the average 28-day strength.

e) The required average compressive strength, f'_{cr}, at 28 days shall be in accordance with the strength shown on the structural drawing sheets.

f) Cylinder testing instances shall be in accordance with the following table.

Table 26-5: No of cylinder test instances

Sl	Description	No of test instances
1	Pile	20
2	Slipway	16
3	Winch Control and Power	12
4	Repair Facility	10
5	RC Pavement and drainage	10
6	Security, Pump and Blasting	08

26.7 BRICKS

Bricks to be used in the project shall be tested for the following properties-

Description	Test Method	Recommended value
Absorption	ASTM C67-14	Less than 15%
Compressive strength	ASTM C67-14	Avg. not less than 30 MPa
Size	ASTM C67-14	±2mm
Efflorescence	ASTM C67-14	No efflorescence

A total of 20 sets of bricks shall be tested. Each set shall constitute 10 nos. bricks collected from site in a random manner following the procedure of ASTM C67-14.

26.8 FLOOR AND WALL TILES

All floor and wall tiles shall be tested for breaking strength in accordance with ASTM C1505-01 (2007). One sample set shall consist of ten tile samples randomly collected from a lot. 5 sets of floor tiles and another 5 sets of wall tiles shall be tested.

CHAPTER 27 REINFORCED CONCRETE RIGID PAVEMENT

27.1 GENERAL

The specification outlined in this chapter is applicable to both the reinforced concrete (RC) heavy duty pavement (hard standing area), light duty RC pavement and other RC pavement works.

27.1.1 Preparation and Stockpiling of Materials

Materials to be used in pavement works shall be processed and stockpiled only in designated areas as approved by the Engineer/PIT. The Bidder shall make all arrangements and bear all costs associated with the provision of these storage areas. Preparation and storage of materials along the alignment will not be allowed.

The designated areas shall be cleared of all vegetation and topsoil prior to commencing work and the arrival of any materials. The area will be graded with proper slopes, drained, and well compacted to provide a plane and hard surface for the stockpiling of materials. The area to be used for stockpiling of concrete/bituminous works aggregates shall be a surfaced platform with a well compacted 150 mm thick layer of stone/gravel/brick aggregate or with brick flat soling over a compacted sand bed. The area of surfaced platform will be sufficient enough to allow stockpiling and handling operations of aggregates without intermixing of different types of aggregates or spilling of aggregates outside the surfaced platform at any stage. All necessary measures shall be taken to prevent contamination of aggregates with silt and clay and other deleterious materials during the stockpiling and handling operations. If any aggregate has been stockpiled outside the surfaced platform, the bottom 300 mm of material shall not be used in the concrete/bituminous works; however, it can be used in other un-important works with the permission of the Engineer/PIT. Similar kinds of precautions shall be taken during stockpiling and handling of stone boulders to be crushed at the plant site to prevent contamination of their products. In any case, any contaminated aggregate shall not be used in the works

Bricks of different frog marks, different materials and size fractions shall be kept in separate stockpiles divided as necessary to prevent contamination.

Unless otherwise approved by the Engineer/PIT, each stockpile shall be built at least 2 metres high. The Bidder shall supply any planking or other material required in connection with movement of vehicles over and about the stockpiles.

27.1.2 Scarification and Preparation of Existing Pavement And/Or Hard Shoulders

This work shall consist of scarifying the existing pavement and shoulders to a depth up to 200 mm, or as ordered by the Engineer/PIT, and over a width as indicated on the Drawings or as instructed by the Engineer. The material shall be thoroughly mixed by means of a motor grader and homogenized with a pulvimixer or similar approved plant or by labor intensive methods. It shall then be spread and compacted, with the addition of water as may be required, in such manner as to obtain a profile conforming with the lines, grades and cross-sections shown on the Drawings, or as directed by the Engineer/PIT.

If there is any suitable surplus material this shall be temporarily stockpiled for subsequent reuse in the Works, as directed by the Engineer/PIT.

Any shortage of materials shall be supplied by the addition of material having engineering characteristics not inferior to those required for sub-base or base, as appropriate. The additional material shall be thoroughly mixed with the scarified and homogenized material, by means of a motor grader, before compacting.

27.1.3 Repair of Potholes and Damaged Areas

The Engineer /PIT may instruct the Bidder to repair potholes or damaged areas on existing bituminous surfaced roads including depressions and broken edges.

The Bidder shall remove the bitumen surface as directed. All damaged and unstable parts of the existing base and sub-base shall be excavated until sound material is reached on all sides and at the base of the excavation. Unsuitable excavated materials shall either be disposed of or stockpiled in locations as directed by the Engineer. The shape of the excavation shall then be made rectangular with vertical sides.

The excavated material, depending on its nature, shall be:

a) stocked adjacent to the Works for reuse, if so directed, or

b) dispose of to spoil, if so instructed in writing by the Engineer.

The bottom of the excavation shall then be shaped, trimmed, watered if necessary, and compacted to the density required for the appropriate pavement layer. The excavation

shall then be filled with base material of the type directed by the Engineer /PITin layers after compaction of not thicker than 100 mm. Each layer shall be properly levelled and watered and carefully rammed or compacted with an approved hand vibratory roller, in order to achieve at least 98% of maximum dry density. At least three tests shall be made for every 1000 sq.m of pavement area. A bituminous leveling course or bituminous surfacing will then be placed after applying tack coat to the bottom layer and outer vertical sides, as directed by the Engineer/PIT.

27.1.4 Leveling Course

Where shown on the Drawings, or as ordered by the Engineer /PIT a leveling course will be constructed on the existing pavement with the materials required in the Drawings or as otherwise ordered by the Engineer. The execution, measurement and payment of the leveling course works shall be in accordance with the relevant provisions of these Specifications, for the material that will be ordered by the Engineer /PIT to be used.

27.2 SUB-BASE

27.2.1 Description

This work shall consist of furnishing, placing and compacting sub-base material on a prepared and accepted subgrade or improved subgrade in accordance with these Specifications, and to the lines, levels, grades, dimensions and cross sections shown on the Drawings or as required by the Engineer/PIT.

27.2.2 Materials

The Bidder shall submit results of material tests on the proposed sub-base material to the Engineer /PIT for his approval at least seven days in advance of its use. Fresh approval shall be required when the material is changed.

Material shall be natural or artificial aggregate material, free from vegetable matter, soft particles, clay and excess silt. Natural and artificial materials may be mixed together provided they fully conform to all requirements of the Specification and the proportions are approved by the Engineer /PIT in writing. If gravel is used as coarse aggregate, it shall contain at least 50% particles (by weight) having broken faces. Natural sand with Fineness Modulus less than 1.0 shall not be allowed to be used in the sub-base material.

The material for sub-base shall conform to the requirements given below:

a) Grading

The grading (washed method) shall conform to grading envelopes A, or B in Table 27-1as specified in the contract; in case the type of grading is not specified in the contract, it shall be as instructed by the Engineer/PIT.

The grading shall not be allowed to vary from coarser side on one sieve to finer side on another sieve within the grading envelope; and the fraction passing the 0.075 sieve shall be not greater than two-thirds of the fraction passing 0.425 mm sieve.

b) Plasticity

The portion of material passing the 0.425 mm sieve shall be non-plastic when tested in accordance with test procedure STP 3.2.

c) CBR

The material shall have a 4 day soaked CBR value not less than 25% when compacted to 98% of maximum dry density as determined by STP 4.5 (Vibrating Hammer).

d) Aggregate Crushing Value/Ten Percent Fines Value

Any material retained on the 10 mm sieve when sampled and tested in accordance with STP 7.7.1 and 7.7.2 shall have an Aggregate Crushing Value of not greater than 38% and the ten percent fines value shall not be less than 75 kN.

Table 27-1: Grading Requirements for Sub-base Material

Grading Requirements for Sub-base Material		
Sieve Size(mm)	Percentage by Weight Passing Sieves	
	Grading A	Grading B
50	100	--
38	90–100	--
20	50–85	100
10	30–65	80–100
5	25–50	50-80
2.4	15–38	35–65
0.600	8–22	15–40
0.300	6–16	10–30
0.075	2–8	5-10

27.2.3 Construction Methods

27.2.3.1 Preparation of Subgrade Or Improved Subgrade

The subgrade or improved subgrade shall be shaped and compacted in conformity with the provisions of earlier provisions of this Chapter and completed ahead of the placing of the sub-base material. Notwithstanding any earlier approval, any damage to or deterioration of the subgrade or improved subgrade, including any increase in moisture content above that permitted to achieve the specified compaction, shall be corrected at the Bidders expense before sub-base is laid.

Preparation and surface treatment of the subgrade or improved subgrade shall be carried out only after completion of any specified subgrade drainage and unless otherwise agreed by the Engineer /PIT immediately prior to laying the sub-base. The sequence of operations shall be as follows:

a) The subgrade or improved subgrade shall be regulated and trimmed so that its finished profile shall not vary by more than 20 mm above or below the specified formation level at any point.

b) The trimmed formation shall be rolled by 1 pass of a smooth-wheeled roller having a load per 100 mm width of roll not less than 214 kg or a vibratory roller having a static load per 100 mm width of vibratory roll of not less than 71 kg or a vibratory plate compactor having a static pressure under the base plate of not less than 1,400 kg/m^2.

27.2.3.2 Spreading Sub-Base

Sub-base shall be spread in layers of nearly equal thickness either by hand or by using a grader or paving machine, with an uncompacted thickness up to 150 mm, subject to the approval of the Engineer. Where sand and aggregates are combined together to meet the specified grading, care shall be taken to prevent segregation of the material into fine and coarse parts. All areas of segregated coarse or fine material shall be corrected, or removed and replaced with material, which conforms to the Specification.

Where the material for shoulders is the same as that used for the sub-base course, the material shall be evenly spread in layers, as herein specified, for the full width of the sub-base course and the shoulders simultaneously.

Where the shoulders are not of the same material as the sub-base course, then the sub base shall be spread to give the required compacted depth and the edge detail shown on the Drawings.

When the sub base is spread contiguous to concrete kerbs or gutters, extreme care shall be exercised not to damage them. Any damage of kerbs or gutters resulting from carelessness or negligent construction methods by the Bidder shall warrant their removal and replacement at the Bidder’s sole expense.

27.2.3.3 Sprinkling, Rolling and Compacting

Immediately after each layer has been spread and shaped to the cross section required each layer shall be compacted with suitable and adequate compaction equipment approved by the Engineer. Rolling operations shall begin from the outer edge of roadbed toward the

centre, gradually in a longitudinal direction; except on super-elevated curves, where rolling shall begin at the low side and progress towards the high side.

If water is required, to bring the sub base to the correct moisture content, it shall be sprinkled on the surface. The bidder shall supply and sprinkle the necessary water at his own expense.

Sub-base material containing excess moisture shall be dried prior to or during compaction. Drying of wet material shall be performed by methods approved by the Engineer, at the expense of the Bidder.

Each layer shall be compacted to at least 98% of the maximum dry density as determined in accordance with STP T4.5 (Vibrating Hammer). Moisture content at the time of compaction shall be the optimum moisture content ± 3%.

The Bidder shall carry out a field compaction trial at the start of constructing the sub-base to determine the optimum moisture content and the required number of passes of his particular compaction equipment to comply with the Specification. This trial will also determine the relationship between the loose and compacted thickness in controlling the loose thickness at the time of spreading the mix. The method will require to be approved by the Engineer /PIT and shall then be used for all subsequent compaction of sub-base material. Such agreement will not, however, relieve the Bidder of his responsibility and in the event that test results later show that the specified compaction is not being achieved all sub base work shall cease and not be resumed until a fresh trial has been undertaken and a revised compaction method approved by the Engineer/PIT.

3 No. in situ density tests in accordance with STP 6.2 (150 or 200 mm diameter) shall be taken for each 1,000 square meters of compacted sub-base, or as directed by the Engineer. If the test results show that the achieved dry density is less than that required, the Bidder shall carry out further compaction to obtain the minimum required dry density.

In order to ensure uniform bearing capacity at the finished sub-base level, CBR measurements may be ordered by the Engineer. The CBR shall be such that the laboratory value obtained from testing in accordance with STP 5.1 on samples compacted to the specified dry density and soaked for 4 days shall exceed 25%. In areas where these requirements are not met, correction shall be made by such measures, as the Engineer /PIT deems necessary.

The finished sub-base shall be checked for level and cross fall and at any point shall not vary more than 15 mm above or below the planned grade or adjusted grade. The thickness of the finished sub-base shall be on average

a) Not less than the required thickness when five thickness measurements are averaged in any 150m length of completed sub-base.

b) Not thinner than 10 mm less than the required thickness at any point

Sub-base which does not conform to the above requirements shall be corrected by scarifying the full depth of the affected areas, adding or removing materials and re-rolling, watering, if necessary, until the entire surface conforms to the correct levels and cross-falls.

The prepared sub-base layer shall be protected against damage until covered by the base course.

27.2.4 Measurement

Sub-base as described in this Section shall be measured by the cubic meters of compacted material in place and accepted. Measurement shall be based on the thickness/cross-section of the sub-base shown on the Drawings and area/length measured on the surface of the road.

27.3 AGGREGATE BASE

27.3.1 Description

This work shall consist of a base Type I or Type II, composed of crushed aggregate material placed and compacted on a prepared and accepted sub-base or other base course in accordance with these Specifications and the lines, levels, grades, dimensions and cross sections shown on the Drawings or as required by the Engineer/PIT.

27.3.2 Materials

Crushed aggregate shall consist of hard durable particles or fragments of rocks or gravel crushed to the required size, and a filler of coarse sand (F.M. more than 1.5) or other finely divided mineral matter. Use of brick aggregate is not allowed in Base Type I; however it may be used for Base Type II if it meets the Specifications requirements. When the stone is produced from crushed rock, it shall be from a source approved in writing by the Engineer, and crushed and screened to achieve the required grading. When produced from gravel, not less than 90% by weight of the coarse aggregate shall be particles having at least one fractured face and not less than 75% by weight of the coarse aggregate shall be particles

having at least two fractured faces and, if necessary to meet this requirement or to eliminate an excess of filler, the gravel shall be screened before crushing.

The Bidder shall submit results of material tests on the proposed aggregate base material to the Engineer /PIT for his approval at least seven days in advance of its use. Fresh approval shall be required when the material is changed or as order of the Engineer/PIT.

The material for base shall conform to the requirements given below:

a) Grading

The grading shall conform to one of the grading envelopes A or B, of Table 27-1. The material shall be well graded within the envelope with no excess or deficiency of any size. The grading (washed method) shall conform to grading envelope A ofTable 27-2. For base type-I and either envelope A or B for base type-II.

The material shall be well graded within the envelope with no excess or deficiency of any size; the grading shall not vary from coarser side on one sieve to finer side on another sieve within the grading envelope. The fraction passing the 0.075 sieve shall be not greater than one-third of the fraction passing 0.425 mm sieve.

b) Plasticity

The portion of material passing `the 0.425 mm sieve shall be non-plastic, when tested in accordance with test procedure STP 3.2.

c) CBR

When tested in accordance with STP 5.1, the material shall have a minimum soaked CBR value at a compaction of 98% of the maximum dry density as determined by STP 4.5 (Vibrating Hammer) as follows:

Base Type I -80%

Base Type II -50%

d) Aggregate Crushing Value/ Los Angeles Abrasion Value (LAA)

The coarse part of material sampled and tested in accordance with STP 7.7.1 and AASHTO T96 shall have Aggregate Crushing Values (ACV) and Los Angeles Abrasion Value (LAA).

Table 27-2: Type of Base

Type of Base	**ACV(%)**	**LosAngeles AbrasionValue(%)**
Base Type-I	Lessthan25%	Lessthan30%

Base Type-II	Lessthan30%	Lessthan35%

Table 27-3: Grading Requirements for Sub-base Material

Grading Requirements for Sub-base Material		
SieveSize (mm)	Percentage by Weight Passing Sieves	
	Grading A	**Grading B**
50	100	--
38	90–100	--
20	50–85	100
10	30–65	80–100
5	25–50	50-80
2.4	15–38	35–65
0.600	8–22	15–40
0.300	6–16	10–30
0.075	2–8	**5-10**

27.3.3 Construction Methods

27.3.3.1 Preparation of Sub-Base

The sub-base or lower base shall be shaped and compacted in conformity with the provisions of earlier sections of this Chapter, to the correct moisture content and be completed for at least 100 metres ahead of the placing of the base material, unless otherwise approved by the Engineer.

27.3.3.2 Spreading Base

The aggregate and sand shall be mixed thoroughly to obtain a homogenous mix complying with the grading requirements of this section. Water shall be added during mixing to keep the mixed material moist so as to prevent segregation during transportation.

Base shall be at or near the optimum moisture content at the time of placing and spread in layers of nearly equal thickness, subject to the approval of the Engineer. Spreading may be carried out by hand or using a motor grader or using a paving machine, but machine laying is preferred. After laying all areas of segregated coarse or fine material shall be corrected, or removed and replaced with material, which conforms to the Specification.

Where the material for shoulders is the same as that used for the base course, the material shall be evenly spread in layers, as herein specified, for the full width of the base course and the shoulders simultaneously.

Where the shoulders are not of the same material as the base course, then the base shall be spread to give the required compacted depth and the edge detail shown in the Drawings.

When the base course is spread contiguous to concrete kerbs or gutters, extreme care shall be exercised not to damage the kerbs or gutters. Any damage of kerbs or gutters resulting from carelessness or negligent construction methods by the Bidder shall warrant the removal and replacement of said kerbs or gutters at the Bidder's sole expense.

27.3.3.3 Sprinkling, Rolling and Compacting

Immediately after each layer has been spread and shaped satisfactorily, each layer shall be thoroughly compacted with suitable and adequate compaction equipment approved by the Engineer.

If the aggregate base material does not contain sufficient moisture to be compacted in accordance with the requirements of this Section water shall be sprinkled. The Bidder shall supply the necessary water at his own expense.

Aggregate base material containing excessive moisture shall be dried prior to or during compaction. Drying of wet material shall be performed by methods approved by the Engineer, at the expense of the Bidder.

Rolling operations shall begin along the edges and overlap the shoulder at least 750 mm, or as close to the outer edge of the shoulder as practicable where a full width roadbed base course is specified on the Drawings, and progress toward the centre, gradually in a longitudinal direction. On super-elevated curves, rolling shall begin at the low side and progress toward the high side. The rolling operation shall continue until all roller marks are eliminated, and the course is thoroughly compacted.

Each layer shall be compacted to at least 98% of the maximum dry density as determined by STP 4.5 (Vibrating Hammer). Density of the compacted aggregate base course shall be determined in accordance with STP 6.2 (150 mm or 200 mm diameter depending on the layer thickness); with at least three tests being made for each 1,000 square metres.

The final shaping and rolling of the shoulders to the full width shall be made after the base course is completed.

27.3.3.4 Surface Tolerance

The finished surface of the aggregate base shall be checked for level and crossfall and at any point shall not vary more than ±10mm from the specified level. The surface shall also be checked for irregularities by a 3m long straight edge laid perpendicular and parallel to the road centreline at intervals not exceeding 20m. The deviation from the straight edge shall not exceed 10mm. Any areas found to be out of tolerance shall be corrected by loosening, adding or removing material, reshaping and re-compacting.

The thickness of the finished base shall be on average

a) not less than the required thickness when five thickness measurements are averaged inany 150m length of completed sub-base.

b) not thinner than 10 mm less than the required thickness at any point

The Bidder shall carry out at his own expense, the reconstruction of areas of aggregate base which are too thin or too variable in thickness to meet this requirement.

27.3.4 Measurement

This item shall be measured as the number of cubic metres of material complete in place and accepted. Measurements shall be based on the thickness/cross section of the base shown on the Drawings and the length/area measured on the surface of the road.

27.4 CEMENT CONCRETE PAVEMENT

27.4.1 Scope of Work

a) The work shall consist of construction of cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross sections shown on the drawings. The work shall include furnishing of all plant and equipment, materials and labor and performing all operations in connection with the work, as approved by the Engineer/PIT.

b) The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the contract drawings.

27.4.2 Materials

27.4.2.1 Cement

Cement shall confirm to the requirements Chapter 5.

27.4.2.2 Admixtures

Admixtures shall confirm to the requirements of Chapter 5.

27.4.2.3 Aggregates

Aggregates shall confirm to the requirements of Chapter 5.

27.4.2.4 Water

Water shall confirm to the requirements of Chapter 5.

27.4.2.5 Deformed Steel Reinforcing Bars for Dowels and Tie Bars

Reinforcing bars for dowels andtie bars shall confirm to the requirements of Chapter 6.

27.4.3 Pre-Moulded Joint Filler

Joint filler board for expansion joints which are proposed for use only at some abutting structures like bridges and culverts shall be of 20~25 mm thickness within a tolerance of ± 1.5 mm and of a firm compressible material and complying with the requirements of BS 5628 Specification for Highway Works, Vol. I Clause 1015. It shall be 25 mm less in depth than. the thickness of the slab within a tolerance of ± 3 mm and provided to the full width between the side forms. It shall be in suitable lengths, which shall not be less than one lane width. Holes to accommodate dowel bars shall be accurately bored or punched out to give a sliding fit on the dowel bars.

27.4.4 Joint Sealing Compound

The joint sealing compound shall be of hot poured, elastomeric type or cold polysulphide type having flexibility, resistance to age hardening -and durability. If the sealant is of hot poured type it shall conform to AASHTO M282 and cold applied sealant shall be in accordance with BS 5212 (Part 2).

27.4.5 Storage of Materials

Storage of materials shall confirm to the requirements of Chapters5 and 6.

27.4.6 Proportioning of Concrete

27.4.6.1 Mix Design

After approval by the Engineer /PIT of all the materials to be used in the concrete, the Bidder shall submit the mix- design based on weighed proportions of all ingredients for the approval of the Engineer. The mix design shall be submitted at least 30 days prior to the paving of trial length and the design shall be based on laboratory trial mixes using the approved materials and methods as agreed to by the Engineer/PIT. The mix design shall be based on the flexural strength of concrete.

27.4.6.2 Cement Content

Cement content shall confirm to the requirements of Chapter 6.

27.4.6.3 Concrete Strength

Concrete strength shall confirm to the requirements given on the drawings.

27.4.6.4 Workability

a) The workability of the concrete at the point of placing shall be adequate for the concrete to be fully compacted and finished without undue flow. The optimum workability for the mix to suit the paving plant being used shall be determined by the Bidder and approved by the Engineer/PIT. The control of workability in the field shall be exercised by the slump test as per STP.

b) The workability requirement at the Batching Plant and paving site shall be established by slump tests carried during trial paving. These requirements shall be established from season to season and also when the lead from Batching plant site to the paving site changes. The workability shall be established for the type of paving equipment available. A slump value in the range of 30 ± 15 mm is reasonable for paving works but this may be modified depending upon the site requirement and got approved by the Engineer. These tests shall be carried out on every truck/dumper at Plant site and paving site initially when the work commences but subsequently the frequency can be reduced to alternate trucks or as per the instructions of the Engineer/PIT.

27.4.6.5 Design Mix

a) The Bidder shall carry out laboratory trials of design mixes with the materials from the approved sources to be used. Trial mixes shall be made in presence of the Engineer /PIT or his representative and the design mix shall be subject to the

approval of the Engineer/PIT. They shall be repeated if necessary until the proportions that will produce a concrete, which complies in all respects with this Specification, and conforms to the requirement of the design/drawings have been determined.

b) The proportions determined as a result of the laboratory trial mixes may be adjusted if necessary during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer/PIT.

c) The Bidder shall submit results of material tests on the proposed materials to the Engineer /PITfor his approval at least seven days in advance of its use. Fresh approval shall be required when the material is changed or as' order of the Engineer/PIT.

27.4.7 Separation Membrane

A separation membrane shall be used between the concrete slab and the subbase. Separation membrane shall be impermeable plastic sheeting 125 microns thick laid flat without creases. Before placing the separation membrane, the sub-base shall be swept Clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300mm and any damaged sheeting shall be replaced at the Bidder's expense; the separation membrane may be nailed to the lower layer with concrete nail.

27.4.8 Joints

27.4.8.1 The Location and Type of Joints

The location and-type of joints shall be as shown in the drawing. Joints shall be constructed depending upon their functional requirement as detailed in the following paragraphs. The location of the joints should be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It should be ensured that the full required depth of cut is made from edge to edge of the pavement. Transverse and longitudinal joints in the pavement and sub-base shall be staggered so that they are not coincident vertically and are at least 1.0m and 0.3m apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and personnel without damaging the texture of the pavement. Sawing operation could start as early as 6-8 hours depending upon the season.

27.4.8.2 Transverse Joints

Transverse joints shall be contraction and expansion joints constructed at the spacing described in the Drawings. Transverse joints shall be straight within the following tolerances along the intended line of joints which is the straight-line transverse to the longitudinal axis of the carriageway at the position proposed by the Bidder and agreed to by the Engineer, except at road junctions or roundabouts where the position shall be as described in the drawings:

Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not be greater than ± 10 mm.

The best-fit straight line through the joint grooves as constructed shall be not more than 25 mm from the intended line of the joint.

Deviations of the joint groove from the best-fit straight line of the joint shall not be greater than 10 mm.

Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width. Transverse joints shall have a sealing groove, which shall be sealed in compliance with provisions given in later part of this Chapter.

27.4.8.3 Contraction Joints

Contraction joints shall consist of a mechanical sawn joint groove, 3 to 5 mm wide and 1/4 to 1/3 depth of the slab ± 5 mm or as stipulated in the drawings and dowel bars complying with provisions given in later part of this Chapter and as detailed in the drawings.

The contraction joints shall be cut as soon as the concrete has undergone initial hardening and is hard enough to take the load of joint sawing machine without causing damage to the slab.

27.4.8.4 Expansion Joints

The expansion joints shall consist of a joint filler board complying with Sec.32.4.3 and dowel bars complying with Sec.32.4.2.6 and as detailed in the drawings. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within the tolerances given in Sec.32.4.9 and at such depth below the surface as will not impede the passage of the finishing straight edges or oscillating beams of the paving machines. The adjacent- slabs shall be completely separated from each other by providing

joint filler board. Space around the dowel bars, between the sub-base and the filler board shall be packed with a suitable compressible material to block the flow of cement slurry.

27.4.8.5 Transverse Construction Joint

Transverse construction joints shall be placed whenever concreting is completed after a day's work or is suspended for more than 30 minutes. These joints shall be provided at the regular location of contraction joints using dowel bars. The joint shall be made butt type. At all construction joints, steel bulkheads shall be used to retain the concrete while the surface is finished. The surface of the concrete laid subsequently shall conform to the grade and cross sections of the previously laid pavement. When positioning of bulk head/ stop-end is not possible, concreting to an additional 1 or 2 m length may be carried out to enable the movement of joint cutting machine so that joint grooves may be formed and the extra 1 or 2 m length is cut out and removed subsequently after concrete has hardened.

27.4.8.6 Longitudinal Joint

a) The longitudinal joints shall be saw cut as per details of the joints shown in the drawing. The groove may be cut after the final set of the concrete joints should be sawn to at least 1/3 the depth of the slab ± 5 mm as indicated in the drawing.

b) Tie bars shall be provided at the longitudinal joints as per dimensions and spacing shown in the drawing and in accordance in Sec.32.4.9.f.

27.4.9 Dowel Bars

a) Dowel bars shall be mild steel rounds in accordance withSec.32.4.2.6 with details/dimensions as indicated in the drawing and free from oil, dirt, loose rust or scale. They shall be straight, free of irregularities and burring restricting slippage in the concrete. The sliding ends shall be sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. The dowel bar shall be supported on cradles/dowel chairs in pre- fabricated joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars besides full re-compaction of the concrete around the dowel bars.

b) Unless shown otherwise on the drawings, dowel bars shall be positioned at mid depth of the slab within a tolerance of ± 20 mm, and centered equally about intended lines of the joint within a tolerance of ± 25 mm. They shall be aligned parallel to the finished surface of the slab and to the center line of the

carriageway and to each other within tolerances given hereunder, the compliance of which shall be checked.

For bars supported on cradles prior to the laying of the slab:

i. All bars in a joint shall be within ± 3 mm per 300 mm length of bar

ii. 2/3rd of the bars shall be within ± 2 mm per 300 mm length of bar

iii. No bar shall differ in alignment from an adjoining bar by more than 3 mm per 300 mm length of bar in either the horizontal or vertical plane.

iv. Cradles supporting dowel bar shall not extend across the line of joint i.e. no steel bar of the cradle assembly shall be continuous across the joint

For all bars inserted after laying of the slab, twice the tolerance for alignment a indicated above.

c) Dowel bars, supported on cradles in assemblies, when-subject to a load of 110 N applied at either end and in either the vertical or horizontal-direction (upwards and downwards and both directions horizontally) shall conform to be within the following limits

i. Two-thirds of the number of bars of any assembly tested shall not deflect more than 2 mm per 300 mm length of bar.

ii. The remainder of the bars in that assembly shall not deflect more than 3 mm per 300 mm length of bar.

d) The assembly of dowel bars and supporting cradles, including the joint filler board in the case of expansion joints, shall have the following degree of rigidity when fixed in position:-

i. For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection after removal of the load shall be not more than 3 mm.

ii. The joint assembly fixings to sub-base shall not fail under the 1.3kN load applied for testing the rigidity of the assembly but shall fail before the load reaches 2.6 kN.

iii. The fixings for contraction joint shall not fail under 1.3 kN load and shall fail before the load reaches 2.6 kN when applied over a length of 600 mm by means of a bar or timber packing placed as near to the level of the line of fixings as practicable.

iv. Fixings shall be deemed to fail when there is displacement of the assemblies by more than 3 mm with any form of fixing, under the lest load. The displacement shall be measured at the nearest part of the assembly to the centre of the bar or timber packing.

e) Dowel bars shall be covered by a thin plastic sheath for at least two-thirds of the length from one end for dowel bars in contraction joints or half the length plus 50 mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25 mm. The sheathed bar shall comply with the following pull-out tests:

Four bars shall be taken at random from stock and without any special preparation shall be covered by sheaths as required in this Section. The ends of the dowel bars which have been sheathed shall be cast centrally into concrete specimens 150 x 150 x 600 mm, made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20 mm and cured in accordance with IS: 516. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25 mm. The average bond stress to achieve this movement shall not be greater than 0.14 MPa.

f) For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipe shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of cement slurry between dowel and cap it may be taped.

g) Tie bars

i. Tie bars in longitudinal joints shall be deformed steel bars of strength in accordance withSec.32.4.2.6. The bars shall be free from oil, dirt, loose rust and scale.

ii. Tie bars projecting across the longitudinal joint shall be protected from corrosion for 75mm on each side of the joint by a protective coating of bituminous paint with the approval of the Engineer. The coating shall be dry when the tie bars are used.

iii. Tie bars in longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of the slab. Alternatively, tie bars at longitudinal joints may be mechanically or manually inserted into the plastic concrete from above by vibration using a method, which ensures correct placement of the bars and re-compaction of the concrete around the tie bars.

iv. Tie bars shall be positioned to remain within the middle third of the slab depth as indicated in the drawings and approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of ± 50mm, and. with a minimum cover of 30 mm below the joint groove.

27.4.10 Weather and Seasonal Limitations

27.4.10.1 Concreting During Monsoon Months

When concrete is being placed during monsoon months and when it may be expected to rain, sufficient supply of tarpaulin or other water proof cloth shall be provided along the line of the work. Any time when it rains, all freshly laid concrete which had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be retextured in accordance with the directives of the Engineer.

27.4.10.2 Concreting In Hot Weather

No concreting shall be done when the concrete temperature is above 30 degree Centigrade. Besides, in adverse conditions like high temperature, low relative humidity, excessive wind velocity, imminence of rains etc., if so desired by the Engineer, tents on mobile. trusses may be provided over· the freshly laid concrete for a minimum period of 3 hours as directed by the Engineer/PIT. The temperature of the concrete mix on reaching the

paving site shall not be more than 30° C. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of.

No concreting shall be done when the concrete temperature is below 5 degree Centigrade and the temperature is descending.

27.4.11 Side Forms, Rails

a. All side forms shall be of mild steel of depth equal to the thickness of pavement or slightly less to accommodate the surface regularity of the ·sub-base. The forms can be placed on series of steel packing plates or shims to take care of irregularity of sub-base. They shall be sufficiently robust and rigid to support the weight and pressure caused by paving equipment. Side forms for use with wheeled paving machines shall incorporate metal rails firmly fixed at a constant height below the top of the forms. The forms and rails shall be firmly secured in position by not less than 3 stakes/pins per each 3 m length so as to prevent movement in any direction. Forms and rails shall be straight within a tolerance of 3mm in 3m and when in place shall not settle in excess of 1.5 mm in 3m while paving is being done. Forms shall be cleaned and oiled immediately before each Use. The forms shall be bedded on a continuous bed of low moisture content lean cement mortar or concrete and set to the line and levels shown on the drawings within tolerances ±10 mm and ±3 mm respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3 mm. The forms shall be got inspected from the Engineer /PITfor his approval before 12 hours on the day before the construction of the slab and shall not be removed until at least 12 hours afterwards.

b. At all times sufficient forms shall be used and set to the required alignment for at least 200 m length of pavement immediately in advance of the paving operations, or the anticipated length of pavement to be laid within the next 24 hrs whichever is more.

27.4.12 Construction

27.4.12.1 General

A systems approach may be adopted for construction of the pavement, and the Method Statement for carrying out the work, detailing all the activities including indication of

lime-cycle, equipment, personnel etc., shall be got approved from the Engineer /PITbefore the commencement of the work. The above shall include the type, capacity and make ofthe batching and mixing plant besides the hauling arrangement and paving equipment. The capacity of paving equipment, batching plant as well as all the ancillary equipment shall be adequate for a paving rate of at least 300 m in one day.

27.4.12.2 Batching and Mixing

Batching and mixing of the concrete shall be done at a central batching and mixing plant with automatic controls, located at a suitable place which takes into account sufficient space for stockpiling of cement, aggregates and stationary water tanks. This shall be, however, situated at an approved distance, duly considering the properties of the mix and the transporting arrangements available with the Bidder.

27.4.12.3 Equipment for Proportioning of Materials and Paving

Proportioning of Material: Proportioning of materials shall be done in the batching plant by weight, each type of material being weighed separately. The cement from the bulk stock may be weighed separately from the aggregates and water shall be measured by volume. Wherever properly graded aggregate of uniform quality cannot be maintained as envisaged in the mix design, the grading of aggregates shall be controlled by appropriate blending techniques. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity of the laying/paving equipment.

Batching Plant and Equipment

a) General: the batching plant shall include minimum four bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dust during operation. Approved safety devices shall be provided and maintained for the protection of all personnel engaged in plant operation, inspection and testing. The batch plant shall be equipped with a suitable non-resettable batch counter, which will correctly indicate the number of batches proportioned.

b) Bins and hoppers: Bins with minimum number of four adequate separate compartments shall be provided in the batching plant.

c) Automatic weighing devices: Batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices using load cells.

d) Mixers: Mixers shall be pan type, reversible type or any other mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specific mixing period, and of discharging the mixture, without segregation. Each stationary mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds or as per the manufacturer's recommendation. The mixer shall be equipped with a suitable non-resettable batch counter, which shall correctly indicate the number of batches mixed.

The mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 20 mm or more. The Bidder shall

i. have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or

ii. provide permanent marks on blade to show points of 20 mm wear from new conditions. Drilled holes of 5 mm diameter near each end and at midpoint of each blade are recommended. Batching Plant shall be calibrated in the beginning and thereafter at suitable interval not exceeding 1 month.

27.4.12.4 Paving Equipment

The concrete shall be placed with an approved fixed form or slip from paver with independent units designed to (i) spread,(ii) consolidate, screed and float-finish, (iii) texture and cure the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary. and- so. as to provide a dense and homogeneous pavement in conformity with the plans and Spe9ifications. The paver shall be

equipped with electronic controls to control/sensor Jine and grade from either or both sides of the machine.

Vibrators shall operate at a frequency of 8300 to 9600 impulses per minute under load at a maximum spacing of 60 cm. The variable vibration setting shall be provided in the machine

27.4.12.5 Hauling and Placing of Concrete

a. Freshly mixed concrete from the central batching and mixing plant shall be transported to the paver site by means of trucks/tippers of sufficient capacity and approved design in sufficient numbers to ensure a constant supply of concrete. Covers shall be used for protection of concrete against the weather. The trucks/tippers shall be capable of maintaining the mixed concrete in a homogeneous state and discharging the same without segregation and loss of cement slurry. The feeding to the paver is to be regulated in such a way that the paving is done in an uninterrupted manner with a uniform speed throughout the days work.

b. Concrete mixed in central mixing plant shall be transported to the site without delay and the concrete which, in the opinion of the Engineer, has been mixed too long before laying will be rejected and shall be removed from the site. The total time taken from the addition of the water to the mix, until the completion of the surface finishing and texturing shall not exceed 120 minutes when concrete temperature is less than 25°Cand 90 minutes when the concrete temperature is between 25°C to 30°C. Trucks/tippers delivering concrete shall not run on plastic sheeting nor shall they run on completed slabs until after 28 days of placing the concrete. The Paver shall be capable of paving the carriage way as shown in the drawings, in a single pass and lift.

c. Where fixed form pavers are to be used, forms shall be fixed in advance as per Sec. 33.4.11. Before any paving is done, the site shall be shown to the Engineer, in order to verify the arrangement for paving besides placing of dowels, tie-bars etc., as per the relevant provisions of this Specification. The mixing and placing of concrete shall progress only at such a rate as to permit proper finishing, protecting and curing of the pavement.

d. In all cases, the temperature of the concrete shall be measured at the point of discharge from the delivery vehicle.

e. The addition of water to the surface of the concrete to facilitate the finishing operations will not be permitted except with the approval of the Engineer /PITwhen it shall be applied as a mist by means of approved equipment.

f. If considered necessary by the Engineer, the paving machines shall be provided with approved covers to protect the surface of the slab under construction from direct sunlight and rain or hot wind.

g. While the concrete is still plastic, its surface shall be brush textured in compliance with Sec. 32.4.12.9 and the surface and edges of the slab cured by the application of a sprayed liquid curing membrane. After the surface texturing, but before the curing compound is applied, the concrete slab shall be marked with the chainage at every 100 m interval.

h. As soon as the side forms are removed, edges of the slabs shall be corrected wherever irregularities have occurred by using fine concrete composed of one part of cement to 3 parts of fine chips and fine aggregate under the supervision of the Engineer.

i. If the requirement for surface regularity fails to be achieved on two consecutive working days, then normal working shall cease until the cause of the excessive irregularity has been identified and remedied.

27.4.12.6 Construction by Fixed Form Paver

a. The fixed form paving train shall consist of separate powered: machines which spread, compact and finish the concrete in a continuous operation.

b. The concrete shall be discharged without segregation into a hopper spreader which is equipped with means for controlling its rate of deposition on to the subbase. The spreader shall be operated to strike off concrete up to a level requiring a small amount of cutting down by the distributor of the spreader. The distributor of spreader shall strike off the concrete to the surcharge adequate to ensure that the vibratory compactor thoroughly compacts the layer. If necessary, poker vibrators shall be used adjacent to the side forms and edges of the previously constructed slab. The vibratory compactor shall be set to strike off the surface slightly high so that it is cut down to the required level by the oscillating beam. The machine shall

be capable of being rapidly adjusted for changes in average and differential surcharge necessitated by changes in slab thickness or cross fall- the final finisher shall be able to finish the surface to the required level and smoothness as 'specified, care being taken to avoid bringing up of excessive mortar to the surface by overworking.

27.4.12.7 Construction by Slip Form Paver

a. The slip form paving train shall consist of power machine which spreads, compacts and finishes the concrete in a continuous operation. The slip form-paving machine shall compact the concrete by internal vibration and shape it between the side forms with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip form paver across the whole width and to a height, which at all times is in excess of the required surcharge. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of the strike off plate or a screw auger device extending across the whole width of the slab. The equipment for striking off the concrete shall be capable of being rapidly adjusted for changes of the average and differential surcharge necessitated by change in slab thickness or cross fall.

b. The level of the conforming plate and finishing beams shall be controlled automatically from the guide wires installed as per Sec. 32.4.11. Sensors attached at the four comers of the slip form paving machine. The alignment of the paver shall be controlled automatically from the guide wire by at least one set of sensors attached to the paver. The alignment and level of ancillary machines for finishing, texturing and curing of the concrete shall be automatically controlled relative to the guide wire or to the surface and edge of the slab.

c. Slip-form paving machines shall have vibrators of variable output, with a maximum energy output of not less than 2.5 KW per metre width of slab per 300 mm depth of slab for a laying speed upto 1.5 m per minute or pro-rata for higher speeds. The machines shall be of sufficient mass to provide adequate reaction during spreading and paving operations on the traction units to maintain forward movements during the placing of concrete in all situations.

d. If the edges of the slip formed slab slump to the extent that the surface of the top edge of the slab does not comply with the requirements of Sec.32.4.17, then special measures approved by the Engineer /PIT shall be taken to support the edges to the required levels and work shall be stopped until such time as the Contract0r·can demonstrate his ability to slip form the edges to the required levels.

27.4.12.8 Construction by Hand Guided Method

Areas in which hand-guided methods of construction become indispensable shall get approved by the Engineer /PIT in writing in advance. Such work may be permitted only in restricted areas in small lengths. Work shall be carried out by skilled personnel ·as per methods, approved by the Engineer. The acceptance criteria regarding level, thickness, surface regularity, texture, finish, strength "of concrete and all other quality ·control measures shall be the same as in the case of machine laid work.

27.4.12.9 Surface Texture

a. After the final regulation of the slab and before the application of the curing membrane, the surface of concrete slab shall be brush-textured in a direction at right angles to the longitudinal axis of the Carriageway.

b. The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450 mm wide but longer brushes are preferred. The brush shall be made of 32-gauge tape wires grouped together in tufts spaced at 10 mm centres. The tufts shall contain an average of 14 wires and initially be 00 mm long. The brush shall have two rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 90 mm long.

c. The texture depth shall be determined by the Sand Patch Test. This test shall be performed at least once for each day's paving and wherever the Engineer /PIT considers it necessary at times after construction as under. Five individual measurements of the texture depth shall be taken at least 2 m apart any- where along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

d. Texture depths shall not be less than the minimum required when measurements are taken as given in the following table nor greater than a maximum average of 1.25 mm.

Time of Test		No of measurements	Required texture depth (mm)	
			Specified value	Tolerance
1.	Between 24 hours and 7 days after the construction of the slab or until the slab is first used by vehicles.	An average of five measurements	1.00	± 0.25
2.	Not later than 6 weeks before the road is opened to public traffics.	An average of five measurements	1.00	+0.25 -0.35

e. After the application of the brushed texture, the surface of the slab shall have a uniform appearance.

f. Where the texture depth requirements are found to be deficient, the Bidder shall make good the texture across the full lane width over length directed by the Engineer, by retexturing the hardened concrete surface in an approved manner.

27.4.13 Preparation and Sealing of Joint Grooves

27.4.13.1 General

All transverse joints in surface slabs shall be sealed using sealants described in Sec 33.4.4. Joints shall not be sealed before 14 days after construction.

27.4.13.2 Preparation of Joint Grooves for Sealing

a. Joint grooves usually are not constructed to provide the minimum width specified in the drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before sealing. Depth/width gauges shall be used to control the dimension of the groove.

b. If rough arises develop when grooves are made they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle up to 10 degree from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10 degrees, the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects up to a

maximum width including any chamfer of 35 mm for transverse joints and 20 mm for longitudinal joints. If the spelling cannot be so eliminated then the arises shall be repaired by an approved thin bonded arris repair using cementitious materials.

c. All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. If need arises the Engineer /PIT may instruct cleaning by pressurized water jets. Depending upon the requirement of the sealant manufacturer, the sides of the grooves may have to be sand blasted to increase the bondage between sealant and concrete.

d. The groove shall be cleaned and dried at the time of priming and sealing.

e. Before sealing the temporary seal provided for blocking the ingress of dirt, soil etc., shall be removed. A highly compressible heat resistant paper-backed debonding strip as per drawing shall be inserted in the groove to serve the purpose of breaking the bond between sealant and the bottom of the groove and to plug the joint groove so that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint.

27.4.13.3 Sealing With Sealants

a. When sealants are applied, an appropriate primer shall also be used if recommended by the manufacturer and it shall be applied in accordance with their recommendation. The sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint roove to be sealed is below 7° C.

b. If hot applied sealant is used it shall be and applied from a thermostatically controlled, indirectly heated preferably with oil jacketed melter and pourer having recirculation pump and extruder. For large road projects, sealant shall be applied with extruder having flexible hose and nozzle. The sealant shall not be heated to a temperature higher than the safe heating temperature and not for a period longer than the safe heating period, as specified by the manufacturer.

The dispenser shall be cleaned out at the end of each day in accordance with the manufacturer's recommendations and reheated material shall not be used.

c. Cold applied sealants with chemical formulation like poly sulphide may be used. These shall be mixed and applied within the time limit specified by the manufacturer. If primers are recommended they shall be applied neatly with an appropriate brush. The Movement Accommodation Factor (MAF) shall be more than 10 per cent.

d. The sealants applied at contraction phase of the slabs would result in bulging of the sealant over and above the slab. Therefore, the Bidder in consultation with the Engineer /PIT shall establish the right temperature and time for applying the sealant. Thermometer shall be hung on a pole in the site for facilitating control during the sealing operation.

e. Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 5 ± 2 mm.

f. During sealing operation, it shall be seen that no air bubbles are introduced in the sealant by vapours or by the sealing process.

g. Curing shall confirm to the requirements of Chapter 5.

27.4.14 Removal of Scaffolding and Formwork

Forms and scaffolding shall confirm to the requirements of Chapter 4.

27.4.15 Repair of Concrete

Repair of Concrete shall confirm to the requirements of Chapter 5.

27.4.16 Measurement of Texture Depth

Sand Patch Method

27.4.16.1 The Following Apparatus Shall be Used

A cylindrical container of 25 ml internal capacity. A flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, stuck to one face, the reverse face being provided with a handle. Dry natural sand with a rounded panicle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.

27.4.16.2 Method

The surface to be measured shall be dried, any extraneous mortar and loose material removed and the surface swept clean using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over the surface, working the disc with its face kept flat in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of peaks.

27.4.16.3 Dimension

The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from 31000/(DxD) mm where D is the diameter of the patch in mm.

27.4.17 Opening to Traffic

No vehicular traffic shall be allowed to run on the finished surface of a concrete pavement within a period of 28 days of its construction and until the joints are permanently sealed. The road may be opened to regular traffic after completion of the curing period of 28 days and after sealing of joints is completed including the construction of shoulder, with the written permission of the Engineer.

27.4.18 Tolerances for Surface Regularity, Level, Thickness and Strength

The tolerances for surface regularity, level, thickness and strength shall conform to the requirements and Control of quality of materials and works shall be exercised satisfactory to the Engineer.

Measurements for Payment

Measurements will be done to confirm the quantity and quality of works as per the contract documents and specifications including drawings approved at later stages. Since the contract will be an EPC and fixed price contract, payment/acceptance will not depend on measurement results, but will depend on the conformity of the work as per the contract documents and specifications including drawings approved at later stages. For the same reason, no payment shall be made either for any demolished parts or for reconstruction,

substitution, extension or other extras, wastages or spillages which the Bidder may incur in executing the work to the complete satisfaction of Project Manager/Consultant /PIT.

CHAPTER 28 DRAINAGE SYSTEM

28.1 EARTH WORK IN EXCAVATION

Earth work in excavation in all kinds of soil for utility and drain trenches including method statement of carrying out the excavation work, laying out, providing center lines, local bench-mark pillars, leveling, ramming and preparing the base, fixing bamboo spikes and marking layout with chalk powder, providing necessary tools and plants, protecting and maintaining the trench dry etc., stacking, cleaning the excavated earth at a safe distance out of the area enclosed by the layout etc. shall be followed in accordance with the specifications provided in Chapter 3 of this document and shall be done to the satisfaction of the Engineer /PIT. However, the Engineer/PIT's approval shall not relieve the bidder of his responsibilities and obligations under the contract.

28.2 RC U-DRAIN

Reinforced concrete (RC) U-drains shall be installed in the project to adequately drain out the rain water from the built-up project area. Layout of the drains shall be in accordance with the tender drawings. For easy drainage of the rain water, pavement and roof surfaces shall be properly sloped towards the drains. Structural details of the U-drains are provided in the tender drawings.

28.3 MATERIALS

28.3.1 Cement

Cement shall confirm to the requirements Chapter 5.

28.3.2 Admixtures

Admixtures shall confirm to the requirements of Chapter 5.

28.3.3 Aggregates

Aggregates shall confirm to the requirements of Chapter 5.

28.3.4 Water

Water shall confirm to the requirements of Chapter 5.

28.3.5 Deformed Steel Reinforcing Bars

Reinforcing bars shall confirm to the requirements of Chapter 6.

CHAPTER 29 SAND COMPACTION PILES

29.1 GENERAL

Sand compaction pile shall generally be used for improvement of the load bearing capacity of soil. The equipment used for sand compaction piles are:

a) Derrick/winch

b) Casing pipe

c) Drop hammer

d) Others

Drop hammer weighing 0.9 ton and above shall be of solid cylinder and sectional area shall be such that itcan play within the casing pipe. Diameter of hammer section shall be about 6mm to 8mm lower than theopening of the casing pipe. The casing pipe shall be of Mild Steel.

29.2 CONSTRUCTION PROCESS

A small hole of about 50mm depth shall be made on the ground with the hammer. Casing pipe shall be installed at that point and kept vertical. The casing pipe shall be held in position with the wire rope connected to the winch i.e. downward movement of the casing pipe shall be restrained.

Coarse sand of F.M. between 1.5 and 2.5 or sand gravel mix as provided in the design shall be placed within the casing pipe (200mm to 300mm dia) upto a depth of about 1.0 to 1.5m.

The coarse sand or sand gravel mix placed at the tip of casing pipe shall then be compacted to form a solid mass by the hammer holding the casing pipe in position.

Casing pipe shall then be allowed to go downward with application of hammer blows on the shoe formed at the tip and shall be penetrated to the desired depth.

As the casing pipe reaches the desired depth, the pipe shall be pulled back by about 30cm from the lowest position and then held firmly from the winch. Artificial shoe shall then be detached from the casing pipe with the hammer blows.

The casing shall be drawn to a desired height and sand be discharged into the casing pipe up to a depth of about 1.5 to 2 times the drawn up height of the casing pipe.

The discharged sand shall be compacted by the hammer and the process of compaction shall continue until the casing pipe reaches the ground surface.

The removed volume of sand or sand gravel mix, measured on the ground, shall be between 120% and 130% of the designed volume.

Effect of improvement of the foundation soil shall be confirmed by SPT, CPT or any other method as approved by the Engineer between and at the centre of piles so as to satisfy the desired bearing capacity.

29.3 MEASUREMENT

Measurement shall be taken for payment in linear meter of pile constructed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawing sand/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

CHAPTER 30 STRUCTURAL STEEL WORKS

30.1 ANCHOR BOLTS

Supplying and fabrication of anchor bolts in RCC and masonry structure as per approved drawing in accordance with BNBC/ AISC standard procedure including surface cleaning, Hot-Dip galvanizing of approved quality and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawings specification and direction of the Engineer-in-charge /PIT. Physical Specifications ASTM F-1554 Grade 55 (or equivalent). Material specification ASTM A 307 (or equivalent).

30.2 STRUCTURAL STEEL SECTIONS

Supplying and fabrication of Pre-fabricated Built-Up sections including Columns, Rafter, Tube, Diagonals etc. along with attaching fasteners/connections as per design and in accordance with BNBC/ AISC standard procedure including surface cleaning and priming with red oxide/gray oxide of approved quality and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A 572 Grade 50 (or equivalent).

30.3 PLATES

Supplying and fabrication of Base plate, End plate, Connection plate, Template, Cleat etc. as per design and in accordance with BNBC/ AISC standard procedure including surface cleaning and priming with red oxide/gray oxide of approved quality and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A 570 Grade 50 or equivalent

30.4 FASTENERS

Supplying and fittings of Hot Dipped Galvanized Nuts, bolts and Washers for Connections with necessary accessories as per design and in accordance with BNBC/ ASTM standard specification and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and

direction of the Engineer-in-charge /PIT. Material Specification ASTM A325/ ISO Grade 8.8.

30.5 PURLINS

Supplying and fabrication of cold-form GP Purlin 2.00mm thick GP-sheeting having minimum yield strength 310MPa min. and with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A607 Grade 45 or equivalent.

30.6 WALL AND ROOF SHEETS

Supplying and fabrication of 0.50mm thick Pre-painted zinc-alum roof sheeting and wall sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A792M Grade 345B: Coating AZ150 (Sysco Taiwan/Tata BlueScope)

30.7 FLANGE BRACE

Supply and installation of Flange Brace (L-75x75x6). Material ASTM A572 Grade 50 or equivalent.

30.8 SAG ROD

Supply and installation of 12mm Dia. Sag rod. Material conforming to ASTM A572 Grade 50 or equivalent.

30.9 RIDGE CAP

Supplying and fabrication of Ridge Cap by 0.50mm thick Pre-painted zinc-alum color profile sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A792M Grade 345B: Coating AZ150 (Sysco Taiwan/Tata BlueScope)

30.10 GABLE TRIMS

Supplying and fabrication of Gable Trims (300mm Girth) by 0.50mm thick Pre-painted zinc-alum color profile sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A792M Grade 345B: Coating AZ150.

30.11 EAVE GUTTER

Supplying and fabrication of Eave Gutter (600mm Girth) by 0.50mm thick Pre-painted zinc-alum color profile sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A792M Grade 345B: Coating AZ150 (Sysco Taiwan/Tata BlueScope)

30.12 BOTTOM TRIMS

Supplying and fabrication of Bottom Trims (340mm Girth) by 0.50mm thick Pre-painted zinc-alum color profile sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material specification ASTM A792M Grade 345B: Coating AZ150 (Sysco Taiwan/Tata BlueScope)

30.13 CORNER TRIMS

Supplying and fabrication of Corner Trims (340mm Girth) by 0.50mm thick Pre-painted zinc-alum color profile sheet with necessary anchoring accessories as per design and in accordance with BNBC/ AISI standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT. Material Specification ASTM A792M Grade 345B: Coating AZ150.

30.14 RAIN WATER DRAIN PIPE

Supply of 4X150mm uPVC rain water down pipe (having wall thickness 4.5 ~ 6.6 mm) with necessary anchoring accessories as per design and in accordance with BNBC/ AISI

standard procedure and also with required pre-installed formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT.

30.15 SEMI-TRANSPARENT FIBER-GLASS ROOF SHEET

Supply and installation of 2.0mm thick fiber glass sheet (semi-transparent sheet) for roof, wall etc. on MS purlin, angle etc. with J hook or screws with washer and putty, all complete as per drawing, specification and direction of Engineer-in-charge /PIT.

a) Insulation: 10mm thick Double Bubble

b) Fasteners: Dia. 20mm / 25mm / 40mm / 50mm

30.16 CABLE/WIRE BRACING

Supply and fixing of cable/wire bracing conforming to "ASTM A475" with a minimum yield strength of 119.3 MPa, with I-bolt and hill side washer, all complete as per drawing, specification and direction of Engineer-in-charge /PIT. Erection of super structure, sheeting and accessories, all complete

30.17 PAINT

Painting of super structure with two coat enamel painting of approved quality with proper cleaning with all cost including supply and carriage of all materials, labors, tools, formwork incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT.

30.18 STAIRCASE

Supplying and fabrication of Stair (1500mm wide) with necessary anchoring accessories and MS railing as per design and in accordance with BNBC/AISI standard procedure and also with required preinstalled formwork and supply and carriage of all materials, labors, tools, incidentals, etc. all complete as per drawing, specification and direction of the Engineer-in-charge /PIT.

CHAPTER 31 MISCELLANEOUS METAL WORK

31.1 Description

Works to be performed under this Section include, but is not limited to, the furnishing and installing of all structural steel and miscellaneous metal work, anchors, bolts and fastenings, and metal fabrications as shown and noted on the Drawings and as specified herein.

Metal work includes steel doors, steel window and glazing thereof, security grilles, stair railing, collapsible gate. M.S. pipe handrails, rolling shutter, boundary gates and other metal works shown on the Drawings or as directed by the Engineer.

The materials, fabrication, workmanship and installation of the entrance gates shall conform to the requirements of this Section.

31.2 Shop drawings

The Bidder shall submit full details, large scale Shop Drawings of all structural steel and metal work, showing sizes, details of fabrication and construction, methods of assembly and installation details to the Engineer for review and approval. The Bidder shall also provide manufacturer’s literature for fabricated items, where necessary.

All shop and field weld shall be indicated by standard welding symbols of the American Welding Society. Drawings shall show the size, length and type of each weld.

31.3 Materials

31.3.1 General

All materials shall be of new stock and of the best commercial quality for the indicated purpose. Stock items shall be well manufactured by concerns having specialization in the particular item free from defects impairing strength, durability or appearance and subjected to the approval of the Engineer.

Manufactured steel clips and angles will require to be accepted where such is the obvious intent of the Drawings.

All anchor bolts and other parts required for securing each item of work to the construction shall be new.

The Bidder shall take and verify all measurements as may be necessary or required. He shall be responsible for all field dimensions, all fittings and the proper attachment of all works included herein.

31.3.2 Steel Materials

Structural Shapes: All structural and miscellaneous steel members and components shall be standard structural sections, shapes and plates, as indicated on the Drawings, conforming to ASTM A 6, ASTM A 36 (minimum yield point of 2530 kg/cm2) of standard specifications for 'Structural Steel for Building' or approved equal.

Structural Tubing: Steel tubes, where indicated, shall be welded steel tubing, conforming to BS 1387:1967 (medium), of size and shape indicated on the Drawings.

Bars: Steel bars shall be made from billet steel and shall conform to ASTM A 616 or approved equal.

31.3.3 Brass

Brass shall be Red Brass, conforming to ASTM Specifications Designation B 36 as amended to date

31.3.4 Anchors, bolts and fastening

Bolts and studs, nuts and washers shall conform to ASTM A-307, A-449 and A-563 as applicable or approved equal.

Anchors, Bolts and Fastening: Bolts and nuts, other than those with self locking screw thread, shall be coarse-thread series. Bolts and nuts shall be the regular hexagon head types.

Washers: Round washers shall be of American National Standard B 27.2 Type, or approved equal. Cut washers shall be placed under all bolts and nuts, bearing on steel and at other locations indicated on the Drawings. Beveled washers shall be square, smooth and sloped so that contact surfaces of bolt head and nuts are parallel.

Galvanizing: All exposed bolts, studs, nuts and washers shall be hot-dip galvanized in accordance with ASTM A 153.

31.3.5 Pipe sleeves

Pipe sleeves through concrete or masonry walls and footings shall be standard weight, wrought iron, mild steel, or cast iron sleeves with not less than 6mm space all around between the sleeve and pipe or conduit.

31.3.6 Pipe

Pipe for handrails, railings, and pipe guards, as shown on the Drawings, shall be welded steel pipe conforming to ASTM A 53, Type E or S, grade A or approved equal. All pipes shall be galvanized.

Pipes for gate frames and other locations, indicated on the Drawings, shall be welded steel pipes, conforming to BS 1387 (medium). Pipe fitting, where indicated or if any required shall conform to ASTM A 420. Standard manufacturer's weldable steel pipe, conforming generally to the foregoing requirements, will be acceptable. All pipes and pipe fittings shall be galvanized.

31.3.7 Electrodes

All arc-welding electrodes shall conform to AWS standards for steel Arc-welding Electrodes. Electrodes shall be rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use.

31.3.8 Concrete and masonry anchors

Where anchors are not included in the concrete or masonry construction, anchors shall be Phillips "Read Head" Concrete or Masonry Anchors manufactured by Phillips Drill Co. "Wej-lt" Expansion Products, Inc., or approved equal of the sizes and types indicated on Drawings or as required.

31.3.9 Grout

Master Builders, "Embcco" Pro-mix Grout, Conrad Sovin's "Metal-mix Grout", Sonneborn's "Ferrolith G Redi-mixed Grout" or approved equal, high strength, non-shrink grout shall be used.

31.4 Miscellaneous Items

Structural steel and miscellaneous metal items and their related components are not necessarily to be described individually. The most important and those requiring details will be described. Structural and miscellaneous items, not mentioned or described, shall be

furnished and installed in accordance with the intent of the Drawings and specifications and as required to complete the specific work.

31.5 Fabrication

Steel works and firms or shops, skilled and experienced in the fabrication of structural steel and miscellaneous metal work, shall perform metal fabrication.

All foreign materials shall be removed and deformations are rectified prior to sizing for fabrication.

Cutting shall be done in a neat and workmanlike manner without damaging the sections. All cuts shall be made square, precise and true to dimensions shown on the Drawings.

The ends of all members shall be carefully reamed out free from burrs before fabrication and shall be checked carefully against deformations and if required such defects shall be rectified.

Tubular sections shall be bent true to profile without any deformation using bending equipment.

Fabrication work shall be neat, true to plumb, square, true to dimension and profile, accurately fitted with tight joints and intersections.

All exposed welded joints shall be grounded smooth without impairing the strength of the joint. Necessary procedures must be adopted prior to making such joints.

Finished surfaces of exposed members shall be smooth and free from markings, burrs or other defects.

31.6 Welded Connections

Welders shall be experienced in the type of welding work to be performed. If at any time the welder’s performance quality is found not satisfactory, as determined by the Engineer, the welder shall be replaced.

Welded connections shall be made in accordance with AWS D 1.1.

Welds exposed in the finished work shall be ground and dressed smooth so that the shape and profile of the welded item is preserved. Embedded metal frames for floors and deck openings shall be with continuous welds at corners and ground smooth where exposed to view.

Railing shall be fabricated in straight run sections with top and intermediate rails, posts and flange connections, welded ready for installation in the field. Splices, where required, shall be reinforced with sleeve within the pipe and secured with set screws on the underside of the pipe.

31.7 Shop coating

All works shall conform to the details of the Drawings and except for galvanized metal brass or bronze, be furnished at the Site with one prime coat of red lead oxide unless otherwise required by the Engineer. The Engineer shall approve the anti-rust prime coat.

Before applying anti-rust prime coat, all rusts, loose milled scales, dirt, welding flux, spatter and other foreign materials shall be removed with wire brushes or steel scrapers. All grease and oil shall be removed by solvent recommended by paint manufacturer. Surfaces shall be dry when painted.

Dissimilar metals shall be insulated from each other with one heavy coat of asphalt paint on contact surfaces in addition to the prime coat specified above.

Prime coat shall be thoroughly and evenly applied and shall be well worked in to corners and joints taking care to avoid sags and runs. Bolts, which are to remain permanently in the work, shall be dipped in paint to cover the entire bolt.

Prime coat shall be omitted from surfaces to be embedded in concrete or masonry. Prime coat shall also be omitted from surfaces to be welded in the field, except where the primer used can be conclusively shown to have no adverse effect on the weld.

The Bidder shall submit the manufacturer’s specification to the Engineer for his approval prior to applying primer.

31.8 Installation

31.8.1 General

Installation of miscellaneous metal works and metal fabrication shall be in accordance with the Drawings and approved Shop Drawings, true and horizontal and perpendicular, as the case may be, plumb, level and square, with angles and edges parallel with related lines of the work.

Shop fabricated items, subjected to damage, shall be braced and carefully handled to prevent distortions or other damage.

Before concrete is placed, items to be installed shall be properly braced to prevent distortion by pressure of concrete.

Field welding, where required, shall conform to the requirements specified for shop fabrication.

31.8.2 Anchors, bolts, studs and fasteners

All anchors, bolts and washers, inserts etc. as required for the installation and completion of the work and other miscellaneous steel or iron fastenings to be installed in forms before concrete placement, or built in to concrete, shall be provided as indicated on Drawings, details, and schedules at the time schedule for the concrete work. Bolts and anchors shall be present by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Expansion bolts, where approved, shall be carefully installed in snug-fitting, smoothly drilled holes, all in accordance with the manufacturer's instructions. Expansion bolts shall be installed so that the load actson the bolt in shear and withdrawal. Expansion bolts shall be carefully located in order to eliminate the risk of damage to concrete reinforcement and other embedded items. Expansion bolts shall not be used except where indicated on Drawings or where first approved by the Engineer in writing.

31.8.3 Base and bearing plates

Bases and plates and pipe posts, where shown in the Drawings, shall be set accurately using a high strength, non-shrink grouting mortar as herein before specified to obtain uniform bearing. Grouting mortar shall be mixed and installed in accordance with the manufacturer's specifications and instructions. Surfaces to receive the grout shall be cleaned and moistened thoroughly immediately before the grout is placed. Exposed surfaces of grout shall be water-cured with wet burlap or rags for 7 days.

31.8.4 Doors, windows and gates

Doors, window units and entrance gates shall be properly and correctly installed by expert persons with all hardware and accessories furnished and installed as shown on the Drawings and as required for complete and finished installations. Doors, windows and gates shall operate freely, properly and smoothly at completion. Glazing of windows shall be performed in accordance with the requirements and procedures as stated previously in the relevant Sub-section.

31.9 Painting

After installation of steel works and metal fabrication, abraded areas, field areas, field bolts and welds to be touched up and spot shall be painted with the same type of corrosion inhibitor primers as were used for shop painting. Field welds shall be thoroughly wire brushed or sanded prior to painting touch up.

All metal surfaces shall then be painted with three coats of an approved synthetic exterior enamel paint for metal as manufactured by “Berger” or approved equal.

31.10 Rolling Shutters

The installation of rolling shutters include supplying, fitting and fixing of rolling shutter of any design and shape made of 24 SWG galvanized plain sheet units minimum 69 mm width having 10 mm and 12 mm dia. circular folding at ends, rolled in machine, locked together properly to form rolling shutter, top of the shutter to be fitted with circular spring box made of 26 BWG sheet, containing best quality spring made in China, nutted with 38 mm GI pipe at one end and the other end nutted to shutter including fitting the GI pipe again with 375 mm x 300 mm x 6 mm pankha at ends with side guide channel (side channel consist of 50 mm x 100 mm x 6 mm MS plate with 2 mm x 19 mm x 3 mm FI bar, middle channel consist of 2 mm x 150 mm x 6 mm MS plate with 2 mm x19 mm x 6 mm fixed to wall or column with clamps embedded in RCC part by cement concrete (1:2:4) including cutting holes (minimum 3 mm x 25 mm x 6 mm) mending the damages, finishing, curing, bottom end of shutter fitted to folded GP sheet (min 125 mm width in two layers), which is again fitted to 25 mm x 25 mm x 3 mm angle, providing handle with FI bar 25 mm x 6 mm and locking arrangement in both sides, painting two coats with approved color and brand of synthetic enamel paint over a coat of priming etc. complete in all respect accepted by the Engineer-in-charge/PIT.

31.11 Measurement

The different items on structural and miscellaneous metalwork, as indicated on the Drawings and specified herein, will be measured by the various units listed in the Bill of Quantities.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Facilities InstallationandCommissioning
Part-2 of 2

Document Code: CW-03

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PREFACE

This document CW-03 is provided to assist installation of various facilities. Specifications provided in this document shall be followed unless more specific information is provided in the drawings or elsewhere in the tender documents. In case of any conflicting scenario across the tender documents regarding technical specifications, the decision of the buyer/owner shall be final.

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Table of Contents

List of Abbreviations

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers.
ASTM	American Standard for Testing Materials
AWWA	American Water Works Association
BDS	Bangladesh Standard
BISF	Bangladesh Insulator and Sanitaryware Factory
BNS	Bangladesh Naval Ship
BRTC	Bangladesh Road and Transport Authority
BS	Bangladesh Survey
BSTI	Bangladesh Standards and Testing Institution
BUET	Bangladesh University of Engineering and Technology
CAD	Computer Aided Design
CC	Cement Concrete
CI	Cast Iron
CP	Chrome Plated
cPVC	Chlorinated Poly Vinyl Chloride
GF	Ground Floor
GI	Galvanized Iron
HP	Horse Power
IEC	Importer Exporter Code
ISO	International Organization for Standardization
LS	Longitudinal Section

MS	Mild Steel
NYY	An electric cable type with Copper core cable (N), PVC insulation (Y), and PVC outer insulation (Y).
PET	Polyethylene Terephthalate
PIT	Project Implementation Team (of the Owner)
PVC	Poly Vinyl Chloride
PWD	Public Works Department of Bangladesh.
psi	pounds per square inch
RCC	Reinforced Cement Concrete
RC	Reinforced Concrete
SHMP	Sodium Hexametaphosphate
SS	Stainless Steel
TIS	Technical Interface Specification
TS	Transversal Section
UK	United Kingdom
USA	United States of America
VDE	Verband der Elektrotechnik

CHAPTER 1 PLUMBING AND PIPING

1.1 SCOPE

This item covers all operation in connection with plumbing and piping as indicated on the drawings. All work shall conform to Bangladesh National Building Code unless otherwise modified.

1.2 GENERAL REQUIREMENTS

1.2.1 Drawings

The drawings indicate the general arrangement of all plumbing and piping details. However, where actual field conditions necessitate a rearrangement, the Bidder shall prepare and submit detailed shop drawings of the proposed rearrangement for approval of the Consultant. Because of the small scale of the drawings, it may not be possible to indicate all offsets, fittings and accessories which may be required. The Bidder shall carefully examine the drawings and investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly, furnishing such fittings, traps, valves and accessories as may be required to. meet such conditions.

1.2.2 Specifications

Materials, Fitting, Fixtures, Equipment required for the works and which are not covered by the detailed specification shall be as recommended by the manufacturer or consistent with good practice and approved by the Consultant.

1.2.3 Gradients

Drain pipes shall be laid to the following gradients unless otherwise specified or shown in the drawings

Size of pipes	Soil pipes	Rainwater/Waste-water pipe
100mm	1 in 40	1 in 60
150mm	1 in 60	1 in 90
225mm	1 in 100	1 in 150
300mm	1 in 180	1 in 250
450mm	1 in 350	1 in 500

1.2.4 Cutting and Repairing

The work shall be carefully laid out in advance and any cutting of construction shall be done only with the written permission of the Consultant. Cutting shall be carefully done

and any damage to the buildings, piping, wiring or equipment as a result of cutting for installation shall be repaired by skilled worker of the trade involved at no additional expense to the EMPLOYER.

1.2.5 Protection of Fixtures, Materials and Equipment

Pipe openings shall be closed with caps or plugs during installation, Fixtures and equipment shall be tightly covered and protected against dirt water and chemical or mechanical injury. At the completion of the work, fixtures, materials and equipment shall be thoroughly cleaned and delivered in a condition satisfactory to the Consultant.

1.2.6 Hydrostatic Pressure

All piping and pipe fittings including specials such as elbows, tees, valves etc. shall be able to withstand a hydrostatic pressure of 27000mm of water, unless otherwise stated.

1.2.7 Location of Pipes

On the ground floor, water and soil pipes will generally follow under the concrete floor in the approximate location as indicated in drawings. Pipe sleeves will be provided for the crossing beams. Pipe locations shall not interfere with the reinforcing steel in the beams or floor slab or with the shear concrete in or near the beams or walls. Prior to placing the pipe, a detailed shop drawing including its location shall be approved in writing by the Consultant.

1.3 APPROVAL AND LIST OF MATERIALS, FIXTURES AND EQUIPMENT

The Bidder shall submit to the Consultant for approval a complete list (in triplicate) of materials, fixtures, fittings and equipment which are to be supplied by him together with the names and addresses of the manufacturers and their catalogue numbers and trade names. The Bidder shall also furnish other detailed information, where so directed, under various items. No consideration will be given to partial lists submitted from time to time.

1.4 EXCAVATING, TRENCHING AND BACKFILLING

In addition to the requirements under Section "Excavating" and "Filling and Grading" the following specification shall be applicable.

a) Banks of trench shall be vertical or as shown in drawing. Width of trench shall be 175mm on each side of the pipe/bell/sockets. The bottom of the trench for sewer shall be rounded so that an arch of the circumference equal to 0.6 times the outside diameter of the pipes rests on undisturbed soil orl50mm layer of

sand filler concrete cradle as shown in the drawing, Bell holes excavated accurately to the size by hand, Soft materials shall be removed and backfilled with approved materials in layer of 150mm and thoroughly compacted to the satisfaction of the Consultant with the formation of an arch as before.

b) Excavated materials shall be deposited at a minimum distance of 450mm from the banks with ground adjacent being graded to prevent water running in.

1.4.1 Limit of Trench Excavation:

No more than 30m of trench shall be excavated in advance for pipe laying unless otherwise directed by the Consultant.

1.4.2 Pipes in Fill Sections:

Pipes in fill Sections may be laid either of the following method

a) By support foundations as shown in drawing.

b) By removing unsuitable materials in trenches and refilling with selected materials compacted in 150mm layers (up to the required density) with the formation of beams of at least one pipe diameter on each side of the pipe with a minimum of 300mm of sand fill over the pipe and150mm below.

1.5 GI PIPE FOR WATER SUPPLY

The GI pipes for water supply shall meet the following specifications.

a) Seamless steel pipes shall be used as stand pipe and riser from water pump to roof tank and shall conform ASTM A53 and capable to withstand test pressure of 680 kPa for 24 hours. Pipes of 65mm and over shall be flanged end types with companion flanges, necessary gaskets, nuts, bolts and all other accessories like dresser coupling for union etc.

b) Galvanized iron pipes shall be used in water distribution mains, which will remain concealed. These steel pipes shall conform to ASTM A120, A135 and shall be welded tubes of screwed and socketed type. GI pipes shall be class A and be equivalent to as specified in BS-1387. Reducing bends and Tees shall be used instead of reducing socket as far as possible. Pipe diameter over 100mm nominal dia. bore shall be flanged type joints with dresser coupling instead of union sock.

c) All fittings shall be GI products of recommended heavy type and shall conform to BS-534. The piping work shall be carried out in accordance with BS - CP - 310

water supply. Pipes shall be jointed preferably with Teflon tape according to manufacturers' instruction and conforming ASME B 1.20.1. However, strands of fine jute may be used for bigger diameter pipes above 25mm dia. with approval of the Engineer /PIT.

d) The distribution line concealed in walls may be a PVC plastic pipe conforming to ASTM D2672, BS3505 class D or TIS 172523 Grade 13.5. PVC pipe shall be socketed and connected to the fixtures through GI socket, elbows or tee. No PVC pipe and fittings shall be exposed. This PVC pipe may only be supplied and installed as per special order and approval of the Engineer /PIT.

e) Vertical piping shall be secured at sufficient close interval to keep the pipe in alignment and the carry the weight of the pipe and the content.

f) Horizontal piping shall be supported at sufficient close interval to keep it in alignment and prevent sagging.

g) Further specification for GI pipe

Sl.	Nom. Dia. (mm)	Pipe wall thickness (mm)	Outer dia. (mm)	Unit weight, (kg/m)	Min. pressure, (kg/cm^2)
1	20	2.65	25.3	1.7	50
2	12.5	2.65	17.8	1.31	50
3	40	3.25	46.5	3.83	50
4	50	3.65	57.3	5.38	50
5	75	3.65	82.3	7.22	50

1.6 CPVC PRESSURE PIPE FOR WATER SUPPLY

Chlorinated PVC (cPVC) pressure pipe for water supply shall have specific gravity 1.35 - 1.45, sustaining minimum water pressure of 2.76 MPa (400 psi) at 22.8^{o}C (73^{o}F) and 0.67 MPa (100 psi) at 82.2^{o}C (180°F) and other physical, chemical, thermal, fire resistivity properties etc. As per BSTI approved manufacturer standards or ASTM, BS/ISO/IS 15801:2008 standards fitted and fixed in position with sockets, bends, tees, reducer etc. with all accessories such as round grating/domed roof grating, bends, sockets, including groove cutting where necessary etc. approved and accepted by the Engineer-in-charge /PIT.

1.7 WATER PIPE CONNECTIONS AND INSTALLATION

1.7.1 Installation

a) The water supply system within the building will get connection from the existing main road water supply service system. After the service connection,

water will be stored in the underground reservoir and from there, water will be lifted to the overhead tank by using pump and feed to the different floors by gravity and also will be used for firefighting.A gate valve and drain valve on the service line shall be installed inside the building. The piping shall be extended to all fixtures, outlet and equipment from the gate valve. The cold-water system shall be installed with a fall toward the shut-off valve. Supply line taken from pressure or gravity tanks shall be valved (approved type) at or near its sources and an interior stop and waste valve or cock shall be provided for each outlet or group of outlets. Stops and waste cock shall be accessible and of such size and so installed as to permit complete drainage of the entire water supply system they serve.

b) A capped tee shall be installed below the shut-off valve on each water service riser in each building.

c) Mains, Branches and Runouts - Piping shall be installed as indicated on the drawings, Pipe shall be cut accurately to measurements established at the building by the Bidder and shall be worked into place without springing or forcing. Care shall be taken not to weaken the structural portions of the building. Piping above ground shall run parallel with the lines of the building unless otherwise shown or noted on the drawings. Branch pipe from service lines may be taken top of main, bottom of main, or side of main using such crossover fittings as may be required by structural or installation conditions.

d) Service pipes, valves and fittings shall be kept at sufficient distance from other work and other services to permit not less than 12mm between finished covering of the different services. No water piping shall be buried in floors unless specifically indicated on drawings. Changes on pipes sizes shall be made with reducing fittings.

e) All water pipes shall be so graded or pitched that the entire system can be drained and the formation traps shall be avoided where possible, but where they occur, each sag, trap or invert shall have provision or complete drainage.

f) Pipe drains indicated on the drawings shall consist of glove valves with renewable disks and hose nipples. Any trapped water line shall be equipped with

a drain cock, a union, a plugged tee, or a nipple and cap at the lowest point in the trapped Section.

g) Expansion and contraction of piping Allowance shall be made throughout for expansion and, contraction of piping. Horizontal runs of piping over 1500mm ln length shall be anchored to the wall or to the supporting construction about midway on the run to force expansion, evenly divided toward the ends.

h) Air Chambers for water hammer control shall be provided on cold supplies at each faucet and control valve and flush valve and where not definitely shown by the drawings shall consist of250mm length of pipe of the same diameter as the branch Supply, fitted with a cap.

i) No plumbing system or part thereof shall be covered until it has been inspected and approved. ‘In brick walls' the pipes shall be supported by concrete at least 38mm thick all around them.

j) If pipes are embedded in wall with insufficient cover (less than 38mm) or if it is carried exposed, it shall be supported by clamps and nails/nuts and bolts according to approved designs/methods. The distance between supports shall not exceed 975mm and anchor bolts shall not be less than 9mm.

k) During installing, every valve shall accompany a union socket and necessary nipples so as to ease the replacement and servicing during maintenance. After installation the valves shall be tested hydraulically for two hours at required minimum pressure approved by the Engineer /PIT.

l) After installation, the pipe system shall be hydraulically tested for two hours at a pressure of 350 kPa for distribution lines and full pressure, i.e. 10% greater than the pump capacity, for riser, without showing any sign of leakage.

m) The pump used for firefighting purpose shall be tested for their performance characteristics.

1.7.2 Groove Cutting

Groove cutting in brick work, RCC floor, including cost for concealing of GI pipe work (12 mm and 20 mm dia.) in brick wall by cutting groove in wall, lintel, beam etc. by any means carefully without damaging the structure and filling the grooves with CC (4:2:1) after laying of pipe including cost of scaffolding, finishing, curing etc. all complete approved and accepted by the Engineer /PIT.

1.7.3 Joints

Threaded pipe - After cutting and before threading, pipe shall be reamed and shall have burrs removed, screw joints shall be made with hemp yarn soaked in China lacqueror with an approved graphite compound applied to male threads only. Threads shall be fully cut and not more than three threads on the pipe shall remain exposed. Caulking of threaded joints to stop or prevent leaks will not be permitted. Unions shall be provided where required for disconnection.

1.7.4 Sterilization

The entire piping system shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine, calcium hypochlorite or chlorinated lime and shall be introduced into the system in a manner approved by the Engineer /PIT. The sterilizing solution shall be allowed to remain in the system for a period of 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million, or unless otherwise directed.

1.8 SEWAGE AND RAIN WATER DRAINAGE SYSTEM

1.8.1 Piping and Fittings

a) uPVC soil and waste pipes and fillings (above ground sewer and drainage) shall comply with ASTM D2665-85 for different diameters and fittings applying to drain, waste and vent. uPVC soil and wastewater pipe of BS 4514 and ISO 4422 shall cover 110mm and 160 mm outer dia. meter with wall thickness ranging 3.2 mm to 3.8 mm the vent pipe will be of size 110 mm.

b) Among the fittings the Y-Joint shall be with or without access. There shall be plain T-joint, sweep bend, P, Q and S traps, socket plug, reducers, 45° bend, 90° bend with/without access (TS, BS or LS) and vent cowl as and where required as per drawing and design. Solvent cement recommended by the manufacturer shall be used for jointing all uPVC pipes and fittings.

c) Horizontal lines shall be properly fitted and fixed with walls and roof by standard clamps at sufficiently close intervals as recommended by the manufacturer to keep it in alignment and prevent sagging and proper slope shall be maintained as per design and isometric drawing.

d) Vertical piping shall be secured at sufficient close interval to keep the pipe in alignment and carry the weight of the pipe and the content.

e) Whenever any waste line meets with soil line shall be properly vented and sealed by providing trap in the waste line just before meeting the soil line. No plain T-Joint shall be used in soil stack and soil lines rather Y-Joint shall be placed with the use of necessary 45° bend as and where necessary. All water closet and long pans shall be provided with connectors (coupling) with or without bend and trap as necessary.

f) There should be inspection chambers/pits to each joint between soil stacks, waste stacks, leaders, all drainage pipes and sewers.

g) Fixtures directly connected to soil stacks, waste stacks, pipes shall be equipped with water-seal trap. All lines of multiple fixtures shall be properly vented as per design and drawing with provision of necessary access, door or door vent. At the end of branch line there shall be at least one access port or clean out socket plug.

h) The leader shall be equipped with strainers. The strainer shall be extended not less than 100 mm above roof surface. The strainer shall have an available inlet area, above roof level, of not less than 1.5 times the area of the leader.

i) After installation, the pipe system shall be hydraulically tested for two hours at a pressure equal to 50 kPa without showing any sign of leakage.

1.8.2 Installation

1.8.2.1 Handling

Pipe and accessories shall be handled in such a manner as to insure delivery to the point of installation in sound undamaged condition. particular care shall be taken not to injure the pipe coating no other pipe or material of any kind shall be placed inside a pipe of fittings after the coating has been applied.

1.8.2.2 Cutting of Pipe

Cutting of pipe shall be of pipe in a neat and workmanlike manner without damage to the pipe. Unless otherwise authorized by the Consultant cutting shall be done by means of an approved type of mechanical cutter. Wheel cutters shall be used when practicable.

1.8.2.3 Placing and Laying

Before installation, the pipe shall be inspected for defects and tapped with a light hammer to detect cracks. Defective, damaged or unsound pipe will be rejected. Deflections from straight line or grade as required by vertical, horizontal curves or offsets, shall not exceed 6/D meter per linear meter of pipe for pipe not more than 350mm and larger in diameter, where D represents the nominal diameter of the pipe expressed in between the center lines extended of any two connecting pipes, If the alignment requires deflections in excess of these limitations, special bends or a sufficient number of shorter length of pipe shall be furnished to provide angular deflections within the limit set forth, as approved by the Consultant. Except where necessary in making connections to other lines or as authorized by the Engineer /PIT, pipe shall be laid with bells facing upgrades. Except at closures, not less than two lengths of pipe shall be in position ahead of each joint, with packing installed and earth fill tamped alongside the pipe, before the joint is poured. Adequate thrust blocking shall be provided for all pressure mains, Exposed ends of pipes in trenches shall be fully protected with a board or other approved stopper to prevent earth or other substances entering the pipes.

1.8.2.4 Bedding and Encasing Pipe Drains

The trench bottom shall be rammed and compacted and carefully shaped as specified in Chapter 3 of CW-02 document, true to the line and grade to the satisfaction of the Engineer /PIT. The drain pipes shall be laid and supported on temporary supports. The jointing shall then be done and after the said pipe Section is tested to the satisfaction of the Engineer /PIT, the pipes shall be laid in position either on the arch so formed in the trench bed or on the concrete bed. When concrete bed issued the side edges will join the bottom of the concrete bed and pipe tangentially as per drawing.The depth of concrete bed shall be increased at joint to maintain uniform thickness from socket surface. The concrete bed shall be cured for ten days. In case of pipes, being laid on earth foundation, the pipes shall be surrounded to a height of at least150mm above its top by medium sand (F.M.>1.2).

1.9 WASTE WATER DRAIN AND VENT PIPING

1.9.1 Drainage Pipes and Vent Piping

All main vertical soil and waste stacks shall be extended full size to end above the roof line as vents, except where otherwise specifically indicated, Where practicable, two or more vent pipes shall be connected together and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of the roof with

horizontal piping pitched down to stacks without forming traps in pipes. Further specifications for pipes of various size and purpose are given below.

a) 150 mm inside dia. best quality uPVC soil, waste and ventilation pipe having specific gravity 1.35 - 1.45, wall thickness 4.5 mm - 5.2 mm, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, earth work excavation and filling with all accessories such as Round grating/domed roof grating bands, sockets etc. approved and accepted by the Engineer-in-charge /PIT (length: 6000 mm each).

b) 200 mm inside dia. best quality uPVC soil, waste and ventilation pipe underground laying having specific gravity 1.35 - 1.45, wall thickness 5.3 mm - 7.8 mm, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, earthwork excavation and filling with all accessories such as Round grating/domed roof grating bands, sockets etc. approved and accepted by the Engineer /PIT (length: 6000 mm each).

c) 40 mm inside dia. best quality uPVC soil, waste and ventilation pipe having specific gravity 1.35 - 1.45, wall thickness 2.5 - 3.0 mm, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, of uPVC Pipe with all accessories such as Round grating /domed roof grating bands, sockets etc. approved and accepted by the Engineer /PIT (length: 6000 mm each).

d) 32 mm inside dia. best quality uPVC soil, waste and ventilation pipe having specific gravity 1.35 - 1.45, wall thickness 2.5 - 3.0 mm, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, of uPVC Pipe with all accessories such as Round grating /domed roof grating bands, sockets etc. approved and accepted by the Engineer-in-charge /PIT.

e) 50 mm inside dia. best quality uPVC soil, waste and ventilation pipe having specific gravity 1.35 - 1.45, wall thickness 3.0 - 3.5 mm, and other physical,

chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, of uPVC Pipe with all accessories such as Round grating /domed roof grating bands, sockets etc. approved and accepted by the Engineer in-charge.

1.9.2 Fittings

Change in pipe size on soil, waste and drain lines shall be made with reducing fittings or recessed reducers. Changes in direction shall be made with the appropriate use of 45-degree eyes, half eyes, long sweep 6mm bends,6mm, 3mm or 2mm bends, except that sanitary tees may be used on vertical stacks and where the changes in direction of flow is from the horizontal to the vertical and on the discharge from water closets. Where it becomes necessary because of space conditions to use short radius fittings in any other location, the approval of the Consultant shall be obtained before they are installed.

1.9.3 Union Connection

Slip joints will be permitted only in trap seals or in the inlet side of the traps. Tucker or hub drainage fittings shall be used for making union connection wherever practicable in connection with dry vents. The use of long screws and bushings is prohibited.

1.10 CLEANOUTS, TEST TEES AND TRAPS

a) Cleanouts shall be the same size as the pipe, except the cleanout plugs larger than 100mm will not be required. Cleanouts outside of the building may be omitted if a cleanout is indicated on building drain immediately inside the building.

b) Test tees with cast iron cleaned plugs shall be installed at the foot of all soil, waste and drain stacks and on each building drain outside the buildings.

c) Traps: Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap. Traps installed on hub and spigot shall be extra heavy cast iron. Traps installed on threaded pipe shall be recess drainage pattern. Plugs shall be accessible inside of access panels if such panels are used.

1.11 PIPE HANGERS AND FIXTURES SUPPORTS

a) pipe hangers and fixture support shall be furnished and set and the bidder shall be responsible for their proper and permanent location.

b) Pipe Hangers, inserts and Supports - Horizontal overhead runs of pipe shall be hung with approved heavy adjustable wrought iron or malleable iron pip, hangers, spaced not over ten feet apart, except hub-and-spigot soil pipe five feet in length or less where hangers shall be spaced five feet apart, close to the hub of pipe. Vertical run-s of pipe shall have heavy wrought-iron clamps or collars for support, spaced not over ten feet apart. Hangers and collars shall be of size proportion.6 to the weight of the pipe supported chain, strap, perforated bar, or wire hangers will not be permitted. Terrazzo hangers may be used where directed or as required in lieu of a separate hanger for each pipe. All hangers shall have short turn- buckle or other approved means for adjustment.

c) Hangers on different services running parallel with each other and near together, shall be in line with each other and near parallel to the lines of the building. Hangers shall have malleable-iron ring with split adjustable swivel nut. Hangers shall be of a design which will permit removal and replacement of band and hanger with hanger without removing pipe Inserts shall be cast-iron, malleable-iron, or prefabricated steel, of a type to receive a machine-bolt head or nut and after installation, shall permit adjustment of the bolt in one horizontal direction and shall be installed before the concrete is poured. Pipe supports shall be installed in an approved manner.

d) Fixture Equipment Supports and Fastenings - Fixtures and equipment shall be supported and fastened in a satisfactory manner. Where secured to concrete or brickwork walls, they shall be fastened with brass bolts or screws in lead sleeve type anchorage units or with expansion bolts.

1.12 GATE VALVES, UNIONS, HOSE BIBS, REDUCERS

1.12.1 Gate Valves

a) 75mm and smaller shall be bronze

b) Larger than 75mm shall be iron body with flange or bell ends. Valves shall have a clear water way equal to the full nominal diameter of valves, and shall open by turning counter clockwise. Unless otherwise noted on the drawings, all valves shall be equipped with hand wheels.

1.12.2 Unions

On ferrous pipe 50mm in diameter and smaller shall be marble-iron zinc coated unions on water piping 60mmin diameter and larger shall be flange pattern and shall be galvanized (Zinc-coated) cast iron. Gaskets for flanged unions shall be of the best quality fiber, plastic, or leather. Unions shall not be concealed in walls, ceilings or partitions.

1.12.3 Hose Bibs

Hose bibs shall be installed where shown on the drawings and shall be single faucet shoulder type with 19mm hose connection.

1.12.4 Pressure Reducing Valves

Pressure reducing valves shall be fixed in position with water mains as shown in drawing and shall maintain a constant pressure of about 0.67 bar to 2.07 bar (10 psi-30 psi) as requested.

1.12.5 Globe Valve

GI Globe valve, threaded joint with sealant etc. complete approved and accepted by the Engineer /PIT.

1.12.6 Check Valve

Brass Check valve, threaded joint with sealant etc. complete approved and accepted by the Engineer-in-charge /PIT.

1.12.7 Water Level Control Valve

Automatic water level control valve water tank float valve with automatic control, low self-complementary water, water full automatic stop etc. all complete approved andaccepted by the Engineer /PIT.

1.13 FLOOR AND AREA DRAINS

a) Floor trap and floor pass shall be of uPVC and installed maintaining proper level with floor. CP grating of 125mm dia. heavy type and approved quality shall be installed in direct contact with the floor above floor trap/floor pass. The floor drain/trap will be traped and floor pass will be non-trap system with single or multiple line connection.

b) Floor traps should have a water seal of 75 mm and shall be provided with removable strainer. Floor and area drains shall be made of high-grade, strong, tough and even-grained metals. Castings shall be free from blowholes, porosity, hard spots, excessive shrinkage, cracks, or other injurious defects. They shall be

smooth and well cleaned both inside and outside and all fins and roughness shall be removed. Castings shall not be repaired, plugged, brazed or "burned-in".

c) The wall thickness of iron castings shall be not less than 12mm. When drains are installed with metal waterproofing, the metal shall be clamped, caulked or soldered water tight to the drains. It shall be equipped with removable strainer. The open area of strainer shall be at least two third of connection area of the drain line to which it connects

1.14 INSPECTION PITS

1.14.1 RCC Inspection Pit

Construction of RCC inspection pit with 150 mm thick RC wall as per design including necessary earth work, side filling and one layer brick flat soling, 150 mm thick (1:3:6) base concrete for making invert channel and 12 mm thick (1:2) cement plaster with neat finishing etc. all complete up to a depth of 1500 mm all complete approved and accepted by the Engineer-in-charge /PIT.

Master-pit: Clear size 900 x 900mm and depth 900mm min.

Inspection pit Clear 600 x 600mm and depth 600mm min.

1.14.2 Masonry Inspection Pit

Construction of masonry inspection pit with 250 mm thick brick work in cement mortar (1:4) including necessary earth work, side filling and one layer brick flat soling, 75 mm thick (1:3:6) base concrete for making invert channel and 12 mm thick (1:2) cement plaster with neat finishing etc. all complete up to a depth of 700 mm approved and accepted by the Engineer /PIT.

Master-pit: Clear size 900 x 900mm and depth 900mm min.

Inspection pit Clear 600 x 600mm and depth 600mm min.

1.14.3 RC Pit Cover

Construction and placing of RC pit cover (slab), concrete ratio (1:2:4) with 10mm dia. bar @ 125mm c/c both direction reinforcement excluding man hole cover including necessary earth work, side filling shuttering, curing, cement plaster (1:4) with neat finishing on edges and top etc. all complete approved and accepted by the Engineer-in-charge /PIT.

1150x1150 x 100 mm RC pit cover

850x850 x 75 mm RC pit cover

1.14.4 600mm Dia. CI Ring Manhole Cover

600mm dia. CI ring manhole cover supply, fitting, fixing, plastering plastering, paint in and finishing, all complete approved and accepted by the Engineer-in-charge /PIT.

1.14.5 400mm Dia. CI Ring Manhole Cover

400mm dia. CI ring manhole cover supply, fitting, fixing, plastering plastering, paint in and finishing, all complete approved and accepted by the Engineer-in-charge /PIT.

1.15 SEPTIC TANK

Construction of septic tank with RC walls of 200mm thickness with two layer reinforcement in both direction as per design and 200 mm thick reinforced cement concrete floor/bottom slab (1:2:4) with 150 mm thick RC walls in partition, 125mm thick RC top slab and 12 mm thick cement plaster (1:4) with N.C.F. of Inner wall, outer wall and floor including supply of materials with necessary shuttering work. MS rod shall be fabricated as per design including supply of MS rod, GI wire etc. Supplying and fixing of 450 mm dia. water sealed heavy type CI manhole cover with locking arrangement. 125mm thick RCC (1:2:4) top slab, including centering, shuttering, fabricating, casting and curing etc. complete up to required depth including necessary earth work in excavation and shoring, bailing out of water and side filling including the cost of all materials, operations and incidental charges etc. Inlet outlet connection shall be made by 200mm x 200mm uPVC Tee including fitting, fixing, making holes and jam and finishing by cement concrete and cement mortar, all complete as per type plan approved and accepted by the Engineer-in-charge /PIT.For 200 users (40 cubic meter volume).

1.16 SOAK WELL

Construction of soak well of inner diameter 2meter and depth 5meter with 250mm thick solid brick work and 250mm thick honey comb brick work with cement mortar 1:4as per design over RC (1:2:4) well curb with 1% reinforcement up to the depth as per drawing with 450mm dia. heavy type CI manhole cover with locking arrangement. Filling the well up to the required depth with graded brick chips and sand including supplying and fabricating MS rod, casting, curing including necessary earthwork excavation, side filling and bailing out of water including cost of all materials. Including connection with septic tank by 200mm x 200mm uPVC Tee and bend. All complete including RC top slab as per design and drawing

approved and accepted by the Engineer-in-charge /PIT. For 200 users (Inner diameter 2meter and depth 5 meter)

1.17 125MM DIA. GRILL GRATING

Supply of MS 125mm dia. Grill grating made of 8mm MS rod for ground floor outside waste water trap mouth and roof rain water trap mouth including welding, galvanizing, painting, placing and fitting as per requirements of both drawings and accepted by the Engineer in charge.

1.18 MS GRILL GRATING

Supply of Galvanized MS Grill grating made of 50mm x 5mm MS flat bar for gutter drain at Basements and GF including welding, galvanizing, placing and fitting as per requirements of both drawings and accepted by the Engineer in charge.

1.19 INSPECTION AND TESTS

1.19.1 Testing

Immediately after the drains are laid, jointed and flushed clean but before covering, all drain pipes shall be inspected, tested for alignment and infiltration to be passed by the Consultant. The testing may be done Section by Section.

1.19.2 Waste and Vent Piping

The entire system shall have all necessary opening plugged to permit the entire system to be filled with water to the level of the highest vent stack. The system shall hold this water for 30 minutes without showing a drop greater than 12mm. When a portion of the system is to be tested the test shall be conducted in the same manner as described for entire system, except that a vertical stack 3.0m (10 feet) above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for 30 minutes

1.19.2.1 **Air Test**

If tests are made with air, a pressure of not less than 3.45 bar (50 psi) shall be applied with a force pump and maintained at least 15 minutes without leakage. A mercury column gauge shall be used in making the air test.

1.19.2.2 **Final Test**

The final test of the complete system may be either a smoke or a peppermint test' when the smoke test is employed, the smoke shall be-produced-by a smoke machine and

pressure equal to 25mmwater column shall be maintained at least 15 minutes before starting inspection. When the peppermint test is preferred, 56.7 gm (2 ounces) shall be introduced in to each line or stack.

1.19.3 Defective Work

If inspection or test shows defects, such defective work- or material shall be replaced and inspection and test repeated. Repairs to piping shall be made with new material. Caulking of screwed joints or holes will not be acceptable.

1.19.4 Cleaning and Adjusting

At the completion of the work, all parts of the installation shall be thoroughly cleaned' All equipment’s, pipe, valves and fittings shall be cleaned of grease and metal cuttings and sludge which may have accumulated by operation of the system for testing, Any stoppage or discoloration or other damage to parts of the building, its finish or furnishings, due to the contraction’s failure to properly clean the piping system, shall be repaired by the bidder without cost to the Employer. Automatic control devices shall be adjusted for proper operation.

CHAPTER 2 FIXTURES FOR TOILTS AND OTHERS

2.1 FIXTURES FOR OFFICERS' COMMON TOILET – MALE AND FEMALE

2.1.1 Single Unit Commode

Supplying, fitting, and fixing of country made European type special quality commode (one piece) including inbuilt flushing unit, of white color, including plastic seat cover with soft closing, cistern system, water consumption 7 litre max., siphon jet dual flushing system which reduce water consumption, hygienic glaze in toilet bowl,glaze in inner waste line, round bowl, outlet range 280~305 mm. The sanitary ware shall conform BDS1162:2014. The glaze shall be thoroughly fused to body. The minimum thickness of body at any section shall be 5 mm. When assembled together and when examined from a distance of 60 cm, the outer surface shall not show to the unaided eye, blemishes or defects in excess of those listed in BDS standard. The mean value of water absorption shall not be greater than 0.5% of the ware when dry. When tested with chemical solutions (Acetic acid, Citric acid, Detergent, Hydrochloric acid, Sodium hydroxide, Sodium stearate and Sulfuric acid of various strength) as per BDS1162:2014 procedure, none of the test pieces should suffer any loss of reflectivity on the glaze. There shall be no crazing and no stain on the ware. The materials used for making glaze shall not contain lead compound. In case of certain coloring oxides used for making colored glaze, the lead content, if any, shall not exceed 5 percent of the weight of the glaze materials. Appliances shall be clearly and indelibly marked at a prominent place, visible even after the appliances are installed with the following: a) manufacturer's name and/or registered trademark, b) the number of Bangladesh standard and c) country of origin. Each product shall also be marked with the BSTI Certification Mark. The fixture should be placed in position preparing the base with cement concrete and with wire mesh or rods if necessary, in all floors including making holes wherever required and mending good the damages and fitting, fixing, finishing, complete with all necessary fittings and connection approved and accepted by the Engineer-in-charge. Other details: approx. Approx. 695~719 x 340~395 mm size, minimum 39.5 kg of weight; Equivalent to RAK: Metropolitan/ Stella: Vivana or similar brand. (Ref: PWD Schedule item no.26.02.1).

2.1.2 Over Counter Wash Basin

Supplying, fitting and fixing of country made glazed vitreous W/H wash basin excluding pedestal. The sanitary ware shall conform BDS1162:2014. The glaze shall be thoroughly fused to body. The minimum thickness of body at any section shall be 5 mm. When assembled together and when examined from a distance of 60 cm, the outer surface shall not show to the unaided eye, blemishes or defects in excess of those listed in BDS standard. The mean value of water absorption shall not be greater than 0.5% of the ware when dry. When tested with chemical solutions (Acetic acid, Citric acid, Detergent, Hydrochloric acid, Sodium hydroxide, Sodium stearate and Sulfuric acid of various strength) as per BDS1162:2014 procedure, none of the test pieces should suffer any loss of reflectivity on the glaze. There shall be no crazing and no stain on the ware. The materials used for making glaze shall not contain lead compound. In case of certain coloring oxides used for making colored glaze, the lead content, if any, shall not exceed 5 percent of the weight of the glaze materials. Appliances shall be clearly and indelibly marked at a prominent place, visible even after the appliances are installed with the following: a) manufacturer's name and/or registered trademark, b) the number of Bangladesh standard and c) country of origin. Each product shall also be marked with the BSTI Certification Mark. The fixture should be placed in position withmin. 38 mm dia.CP brass bottle trap with brass coupling to concealed in the wall vertical PVC waste pipe of dia. 50mm, including making holes in walls and floors and fitting with RC counter top slab, screws and mending good the damages, finishing etc. The work also includes construction of the reinforced concrete counter top slab and covering its top, front and sides with 18mm thick mirror polished Italian/Turkish natural marble slab/panels of approved texture, creating proper shaped opening in the slab and marble to fit the basin etc. all complete approved and accepted by the Engineer-in-charge. Other details: over counter: Approx. 445 x 345 mm, minimum weight 7.0 kg. (Ref: PWD Schedule item no.26.12.2).

2.1.3 Hand Dryer

Automatic touchless stainless steel body high speed jet air hand dryer, power 1200w, air speed 70m/s with installation, all complete approved and accepted by the authority.

2.1.4 Double Coated Mirror

Supplying, fitting and fixing of 5 mm thick unframed super quality double coated mirror with all necessary fitting including making holes in walls and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer-

in-charge.Other details: local mirror, size 550x 425x 5 mm. (Ref: PWD Schedule item no. 26.19.1).

2.1.5 Colored Glass (Plate) Shelf

Supplying, fitting and fixing of super quality 600 mm x 125 mm colored glass (plate) shelf having 5 mm thickness with fancy CP brackets, screws and frames including making holes in walls and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer- in- charge. (Ref: Schedule item no. 26.20).

2.1.6 Towel Rail and Ring

Supplying, fitting and fixing of country made best quality towel rail/ ring/ shelf minimum 20 mm in dia. with CP holder including making holes in walls and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer-in-charge. Other details:

a) CP towel ring. (Ref: PWD Schedule item no. 26.22.1).

b) 600 mm long CP single towel rail. (Ref: PWD Schedule item no. 26.22.2).

2.1.7 Paper Holder

Supplying, fitting, and fixing of best quality toilet paper holder of standard size including making holes in walls and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer-in-charge. Other details: stainless steel toilet paper holder. (Ref: PWD Schedule item no. 26.23.4).

2.1.8 Soap Tray

Supplying, fitting and fixing of standard size country made soap tray including making holes in walls and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer-in-charge. Other details: stainless steel soap tray. (Ref: PWD Schedule item no. 26.24.4).

2.1.9 Liquid Soap Dispenser

Supplying, fitting and fixing of Push-Up type liquid soap dispenser to dispense 16 oz (.47 liters) of soap, detergent or lotion. Unit shall be fabricated of tamper resistant, chrome plated plastic, a translucent white polyethylene soap container, and a corrosion resistant dispensing valve which can provide no more than 5 lbs (22.2 Newtons) pressure and unit can be reloaded by unscrewing base from bracket collar, inverting unit, and un-screwing soap container in which soap will continue to feed properly until empty with a continuously visible

soap level etc. all complete approved and accepted by the Engineer-in-charge. Other details: push-up type liquid soap dispenser (local): super quality. (Ref: Schedule item no. 26.26.2).

2.1.10 Floor Drain with Vertical Outlet

Supplying, fitting and fixing of 100 mm floor drain with vertical outlet in traps including making holes in walls/floors and mending good the damages with cement mortar (1:4) etc. all complete approved and accepted by the Engineer- in- charge. (Ref: PWD Schedule item no.26.28).

2.1.11 Stop Cock

Supplying, fitting and fixing of best quality surface mounted or conceal stop cock and angle stop cock (lever or round headed) with wall flange chromium plated. The faucet conforms BDS EN 200:2009. The faucet tap shall be free from any leakage, permeation and other abnormalities. The water hammer value shall be 1.47 MPa or under. The faucet after it has been operated 100000 times it shall be free from a seat- leakage and shall satisfy the reverse flow preventing performance. The inside and outside surfaces of the faucet shall be smooth and be free from blowholes, fissures, remarkable flows or injurious defects. The chromium plating on the faucet shall be of class 2 grade 1. The final coating should be done with chromium of minimum 0.1 micron. The faucet shall be made leak proof and fixing in position with selected tape etc. all complete approved and accepted by the Engineer-in-charge. Other details: 20 mm dia. CP Concealed Stop Cock. (Ref: Schedule item no. 26.30.2).

2.1.12 Sink Cock

Supplying, fitting and fixing of best quality sink cock made from copper or copper alloy, chromium plated. The faucet conforms BDS EN 200:2009. The faucet tap shall be free from any leakage, permeation and other abnormalities. The water hammer value shall be 1.47 MPa or under. The faucet after it has been operated 100000 times it shall be free from a seat-leakage and shall satisfy the reverse flow preventing performance. The inside and outside surfaces of the faucet shall be smooth and be free from blowholes, fissures, remarkable flows or injurious defects. The chromium plating on the faucet shall be of class 2 grade 1. The final coating should be done with chromium of minimum 0.1 micron. The faucet shall be made leak proof and fixing in position with selected tape etc. all complete approved and accepted by the Engineer- in- charge. Other details: 12 mm CP concealed super quality moving sink cock. (Ref: PWD Schedule item no. 26.33.2).

2.1.13 Push Shower

Supplying and fitting-fixing stainless steel hand / push shower for water closet including 1.2m long flexible pipe, holder etc. all complete approved and accepted by the Engineer- in-charge. Moving type push shower. (Ref: Schedule item no. 26.39.2).

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

Internal Electrification
Distribution Substation
Emergency Generator
Air Conditioning
Fire Detection and Fire Hydrant System
Security Surveillance CCTV System
LAN/Internet etc.

Document Code: CW-04

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PREFACE

This document CW-04 is provided to assist installation of various facilities. Specifications provided in this document shall be followed unless more specific information is provided in the drawings or elsewhere in the tender documents. In case of any conflicting scenario across the tender documents regarding technical specifications, the decision of the buyer/owner shall be final.

Table of Contents

ABBREVIATION

AAAC	All Aluminum Alloy Conductor
AAC	All Aluminum Conductor
ABB	Asea Brown Boveri
AC	Alternating Current
ACB	Air Circuit Breaker
ACL	Access Control List
ACSR	Aluminum Conductor Steel Reinforce
ACT	Advanced Communications Technology
AISI	American Iron and Steel Institute
AMF	Automatic Mains Failure
AMP	Ampere
ANSI	American National Standard Institute
ASA	Acoustical Society of America
ASEB	Alarm and Status Electronics Board
ASTM	American Society for Testing And Materials
ATS	Automatic Transfer System
AVR	Automatic Voltage Regulator
AWG	American Wire Gauge
BAR	Metric Unit of Pressure
BBT	Bus Bar Trunking
BCU	Bay Control Unit
BD	Bangladesh
BDS	Bangladesh Standard
BDV	Break Down Voltage (Oil)
BIL	Basic Impulse Level
BIS	Bureau of Indian Standards

BLC	Back Light Compensation
BPDB	Bangladesh Power Development Board
BS	British Standards
BSS	British Standard Society
BTU	British Thermal Unit
BUET	Bangladesh University of Engineering And Technology
BYA	PVC (Skin Coated) Insulated Non-Sheathed Single Core Cable
CAT	Computer Aided Testing
CB	Circuit Breaker
CB	Citizens' Band
CBIP	Central Board of Irrigation and Power
CC	Constant Current
CCT	Correlated Color Temperature
CCTV	Closed-Circuit Television
CCU	Current Converter Unit
CE	Conformité Européenne
CENELEC	Commission Européenne De Normalisation Électrique
CFC	Chlorofluorocarbons
CFL	Compact Fluorescent Lamp
CID	Your Caller ID Information
CIGRE	Conseil International Des Grands Réseaux Electriques
CM	Centimeter
CMR	Common Mode Ratio
CO	Close Open Operation
CP	Codes of Practice, British Standards
CPRI	Common Public Radio Interface
CPRI	Central Power Research Institute

CPU	Central Processing Unit
CQC	Coordinated Quality Control
CRCA	Cold Rolled Close Annealed
CRGO	Cold Rolled Grain Oriented Steel
CRI	Color Rendering Index
CSA	Canadian Standards Association
CSC	Containers Safety Convention)
CST	Chronological Sample Taker Log (Schlumberger)
CT	Current Transformer
CVBS	Composite Video Baseband Signal
CVM	Collection Volume
DB	Decibel
DC	Direct Current
DELTA	Electrical Connection Of 3-Phase System Without Neutral
DFT	Dry Film Thickness
DG	Diesel Generator
DHCP	Dynamic Host Configuration Protocol
DIA	Direct Internet Access
DIN	Deutsches Institut Für Normung
German	Institute for Standardisation
DIP	Dual In-Line Package Switch
DISA	Direct Inward System Access
DNR	Digital Noise Reduction
DPDC	Dhaka Power Distribution Company Limited
DVD	Digital Versatile Disc
DWDR	Digital Wide Dynamic Range.
EC	Electrical Conductivity

ECC	Earth Continuity Conductor
EER	Energy Efficiency Ratio
EF	Energy Factor
EFP	Emergency Fire Pump Engine Driven
EHV	Extra High Voltage
EMI	Electro Magnetic Induction
EMI	Electromagnetic Interference
EN	European Standards
EPA	Electrostatic Protected Area
EPDM	Ethylene Propylene Dione Monomer
ERW	Electric Resistance Welded Pipe
ESEAT	Early Streamer Emission Air Terminal
ETL	Electrical Testing Laboratories
EU	European Union
FACP	Fire Alarm Control Panel
FCC	Federal Communications Commission
FM	Frequency Modulation
FOB	Free on Board
FRLS	Flame Retardant Low Smoke
GA	Gigaampere
GB	Giga Byte
GF	Ground Fault Interrupter
GI	Galvanized Iron
GIS	Gas Insulated Substation
GOOSE	Generic Object Oriented Substation Events
GPM	Gallons Per Minute
GTP	Guaranteed Technical Particulars

HD	High Definition
HDD	Hard Disk Drives
HDMI	High-Definition Multimedia Interface
HP	Horse Power
HRC	High Rupture Capacity
HT	High Tension
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
HV	High Voltage
HZ	Hertz Equals the Number Of Cycles Per Second
IC	Integrated Circuit
ICD	Interface Control Document
IDC	Internet Database Connector
IDMT	Inverse Definite Minimum Time
IDMTL	Triple PoleOver Current Relayof IDMT Type
IEC	International Electro technical Commission
IED	Intelligent Electronic Device
IEE	Institution of Electrical Engineers
IEEE	The Institute of Electrical and Electronics Engineers
IES	Internet Enhanced Service
IGMP	Internet Group Management Protocol
IK	Impact Protection
ILAC	International Laboratory Accreditation Cooperation
IP	Internet Protocol
IPS	Instant Power Supply Unit
IR	Insulation Resistance
IR	Infrared Radiation

IS	Indian Standard
ISO	International Standard Organisation
ISS	Information Security Standard
JIS	Japanese Industrial Standards
JPEG	Joint Photographic Experts Group
kA	Kilo Ampere
KEMA	Keuring Van Elektrotechnische Materialen Te Arnhem
kN	Kilo Newto
KOH	Potassium Hydroxide
kV	Kilo Volt
kVA	Kilo Volt Ampere
kVAH	Kilo Volt Ampere Hour
kVAR	Kilo Volt Ampere Reactive
kVP	Kilovoltage Peak
kW	Kilo Watt
kWH	Kilo Watt Hour
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LFP	Link Fault Pass Through
LM	Luminous Flux
LPCB	Loss Prevention Certification Board
LSC	Lightning Protection Company
LT	Low Tension
LTCC	Low Temperature Co-Fired Ceramic
LV	Low Voltage
LX	Long Wavelength

MAC	Media Access Control
MAN	Metropolitan Area Network
MB	Megabyte
MCB	Miniature Circuit Breaker
MCC	Motor Control Centres
MCCB	Moulded Case Circuit Breaker
MCOV	Maximum Continuous Operating Voltage
MDB	Main Distribution Board
MDI	Medium Dependent Interface Port
MFP	Motor Driven Fire Water Pump
MIL	Mil Is a Unit of Area
MIMIC	Microwave Monolithic Integrated Circuit
MPPT	Maximum Power point tracking
MOG	Magnetic Oil Gauge
MOV	Metal Oxide Varistor
MS	Mega Siemens
MV	Mega Volt
MVA	Mega Volt Ampere
NABL	National Accreditation Board for Testing and Calibration Laboratories
NAC	Notification Appliance Circuit
NAS	Network-Attached Storage
NC	Normally Close
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NO	Normally Open
NOX	Nitrogen Oxides
NPT	National Pipe Thread

NST	Network Systems Technician
NVR	Network Video Recorder
NYY	Cable of copper core with an inner PVC insulation and outer PVC sheath
OAM	Operations, Administration, And Maintenance
OC	Open Circuit
OLTC	On-Load Tap Changer
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
ONVIF	Open Network Video Interface Forum
OSR	Oil Surge Relay
OTI	Oil Temperature Indicator
PABX	Private Automated Branch Exchange
PC	Printed Circuit
PCB	Printed Circuit Board
PCD	Pitch Circle Diameter
PCM	Pulse-Code Modulation
PE	Protective Earth
PF	Power Factor
PFI	Power Factor Improvement
PH	Potential of Hydrogen
PI	Polarization Index Test
PLC	Programmable Logic Circuit
PMI	Picture Mastering Index
POE	Power Over Ethernet
PRP	Prime Power
PRV	Peak Reverse Voltage

PSI	Pounds Per Square Inch
PT	Potential Transformer
PVC	Polyvinyl Chloride
PV	Photovoltaic System
PWM	Pulse Width Modulation
RAID	Redundant Array of Independent Disks
RAM	Radom Access Memory
RCA	Radio Corporation of America
RCC	Reinforced Cement Concrete
RCT	Reverse Conducting Thyristor
RE	Solid Single Round Conductor
REB	Bangladesh Rural Electrification Board
REF	Restricted Earth Fault
RELAY	Device of Protection of Electrical Circuit
RF	Radio Frequency
RFI	Radio Frequency Interference
RH	Relative Humidity
RI	Radiated Immunity
RJ	Registered Jack
RMON	Remote Network Monitoring
RMS	Root Mean Square Value
ROHS	Restriction of Hazardous Substances
RPM	Rate Per Minute
RS	Effective Series Resistance
RTCC	Remote Tap Change Control Panel
RTU	Remote Terminal Unit
RYB	Electrical Phase Color Code

SATA	Serial Advanced Technology Attachment,
SCADA	Supervisory Control and Data Acquisition
SD	Trip Indication
SDB	Sub Distribution Boards
SDC	Switch Disconnector
SDCM	Standard Deviation Color Matching
SFP	Small Form-Factor Pluggable
SGS	Société Générale De Surveillance
SL	Switched Live
SMART	Synthetic Multiple Aperture Radar Technology
SNMP	Simple Network Management Protocol
SP	Single Pole
SPD	Surge Protective Devices
SS	Substation
SSH	Secure Shell
ST	Shunt Trip
STB	Separate Terminal Block
STD	Estimated Noise Standard Deviation
STP	Spanning Tree Protocol
SVC	Switched Virtual Circuit
SWG	Standard Wire Gauge
SX	Short Wavelength
TACACS	Terminal Access Controller Access Control System
TCP	Transmission Control Protocol
TDR	Time-Domain Reflectometer
TFTP	Trivial File Transfer Protocol
TIA	Transimpedance Amplifier

TNT	Transparent Network Transport
TP	Triple Pole
TPN	Three Phase Neutral
TR	Tamper-Resistant
TV	Television
TX	Transmission
UHD	Ultra High Definition
UK	United Kingdom
UL	Underwriters' Laboratories
UPS	Uninterruptible Power Supply
USA	United States of America
USB	Universal Serial Bus
UTP	Unshielded Twisted Pairs
VA	Volt-Ampere
VCB	Vacuum Circuit Breaker
VDC	Direct Current Voltage
VDE	Verband Der Electrotechnics’ German Standard
VGA	Video Graphics Array
VLAN	Virtual Local Area Network
VOE	Voice Over Ethernet
VPI	Voltage Presence Indicator
VPR	Voltage Protection Rating
VT	Voltage Transformer
VVVF	Variable Voltage Variable Frequency
WTI	Winding Temperature Indicator
XD	Reactance Sub Transient
XLPE	Cross-Linked Polyethylene

CHAPTER 1 11KV SUB-STATION SYSTEM

1.1 SPECIAL INSTRUCTION TO TENDERERS

1.1.1 Conformity with Specifications

Only general specifications are given. Small details which are not shown or specified on the drawings or in the specifications and schedule shall be included in the supply and installation. Tender shall conform to the technical requirements outlined in the specifications.

1.1.2 Technical Data

Complete catalogue/brochure with technical specifications, performance data sheet indicating capacity at specified conditions, dimension, weight etc. and operating manuals relating to the equipment offered shall be submitted in original with the technical offer, clearly marking the offered model, without which the offer will not be considered. Details of accessories and optional items offered shall be given in writing in the manufacturer's invoice. Documents containing HT Panel, Transformer, LT Panels, PFI Panels, BBT's, and Generators etc. shall enclosed. These documents will not be returned.

1.1.3 Codes and Standard

All equipment's and materials must be in conformity with the most recent relevant Bangladeshi laws, standard rules and regulation. All equipment and materials to be supplied, which required any. Form of approval by the Bangladesh Government or a Local Authority like BPDB/WZPDCL must satisfactorily pass all inspection and tests procedures imposed by them.Otherwise, all the equipment and materials must be in conformity with the most recent international rules, regulation, standards and recommendation: IEC.

1.1.4 Supervision by Bidder

a) The bidder shall depute to the site sufficient and agreed number of experts to closely supervise the entire work, including installation, testing and commissioning of the Owner's Engineer/ PIT/technicians. Such personnel shall normally remain at the site throughout the period of installation.

b) In order to ensure continuity of efficient post- installation services it is essential that the Bidder shall have qualified and sufficiently trained engineers/ PIT and technicians on sub-station works permanently employed under him and debuted to

the job remain and work at the site throughout the period of installation. The tenderer shall furnish with the Technical Offer a list of such Project Staff as are proposed to be employed in the Project with particulars of their proposed position, qualifications, training and experience etc. and also with documentary evidence to the effect that those personnel are genuinely under full time permanent employment of the tenderer at the time of submitting tender.

1.1.5 Country of Origin

The country of origin of the various equipment/components will be as follows or its equivalent manufacturer from UK/Germany/France/Italy/USA/Japan:

i.	11kV Switchgear (VCB) Vacuum Circuit Breaker)	:	Siemens(Germany), Eaton(USA/UK), ABB(Germany), Schneider (France)
ii.	LT panel and PFI plant (main operating components only)	:	Locally assembled BUET/KET/RUET/CUET certified company with main component capacitor, circuit breaker from Siemens (Germany), ABB(Germany/Italy), Schneider(France), Frako (Germany), Roederstein (Germany), Eaton(Moeller) (USA/UK), Dormansmith (England). IES (UK).
iii.	Power DRY Type 11/.4kV Transformer	:	Siemens(Germany), ABB(Germany), Schneider (France),
iv.	Air Circuit breaker/ TPMCCB/ SPMCB/ TPMCB	:	ABB (Germany), Siemens (Germany), Schneider(France), Eaton (USA/UK)
v.	300kVA Diesel Generator	:	Wartsilla (Finland), Caterpillar (USA), Scania (Sweden), SEMT Pielstick (France), MAN (Germany), MTU (Germany), Moteurs Baudouin (France)

1.1.6 Manufacturing Country

Any of the country of origin. For 300 kVA Diesel Generator, any of the country of origin or China.

1.1.7 Particulars of The Equipment

Electrical equipment shall conform to 415V, 3-phase/240V single phase, 50Hz. The routine test/type test certificate of AVR, transformer, VCB, ACB, MCCB, BBT and DG sets from the manufacture of equipment must be submitted during delivery of the equipment.

1.1.8 Testing and Training

Bidder shall arrange relevant Testing of domestic cable of BYA (FRLS) of rating 450/750volts and low voltage NYY power cable of rating 600/1000volts and 11kV NYSEYFGbY cable at BUET's Lab.

1.2 TECHNICAL SPECIFICATION OF SUB-STATION

1.2.1 General Specification

The specification for the parts of this contract mentioned below cover design, manufacture, assembly and testing at the bidder's workshop as well as the supply, delivery, installation, testing and commissioning of the sub-station equipment at site.

1.2.2 Climatic Conditions

The climate is tropical and has marked Monsoon character with seasonal changes from humid, warm, rainy season, summers to cool and dry winters. Maximum temperature occurs during the period from April to May reaching approximately 45-50 deg. Celsius with a relative air humidity of 60% to 80%.

The annual mean temperature is approximately 29 deg. C (84 deg.F). During the rainy monsoon month from June to September, the average relative air humidity is 90%. The annual rainfall, most of which occurs from June to September is 2000mm to 2500mm.

1.2.3 Operating Conditions

The sub-station equipment will be connected to the 33kV, 3-phase, 50 Hz Bus of Power Development Board Bangladesh.

1.2.4 Standards

All equipment's and materials must be in conformity with the most recent relevant Bangladeshi laws, standard rules and regulation. Particular attention is to be paid to the Electrical Act 1910 and Electricity Rules 1937 (as amended in 1946). All equipment and materials to be supplied, which requires any form of approval by the Bangladesh Government or a Local Authority like PDB/DPDC or REB must satisfactorily pass all inspection and tests procedures imposed by them. Otherwise, all the equipment and materials must be in conformity with the most recent international rules, regulation, standards and recommendation: IEC.

1.2.5 Standard Data

The following standard values for high and low voltage are standard in Bangladesh.

Distribution Bus High Voltage: 11kV, Maximum System Voltage 12 kV.

Low Voltage 415/240V Local Voltage

400/231-Opening Voltage

457V-Maximum Permissible Voltage by PDB

1.2.6 **Frequency**

The standard power frequency in Bangladesh will be: 50Hz.

1.2.7 **Design and Construction Requirements**

All equipment is to be in accordance with the latest recognized rules of workmanship and modern engineering practice.

All parts of the equipment's must be suitable in every respect for continuous operation at maximum output under the climatic conditions as specified above.

1.2.8 **Marking of Terminals**

The terminals shall be marked in accordance with BS, IEC, VDE or equivalent standards.

1.2.9 **Painting**

Protective painting shall be done in accordance with general practice and recognized methods, the paint manufacturer's instruction and according to the present addition of DIN 55 928, CORROSION PROTECTION OF STEEL STRUCTURE' such as to meet the tropical condition at site.

1.2.10 **Earthing of Equipment**

Electrical equipment must be provided with an earthing screw of sufficient diameter or an earthing plate.

1.2.11 **Insulation Co-Ordination**

The insulation level for load break switch, lightning arrestor and transformer are stipulated below, taking into account the maximum service voltage and the rated voltage according to IEC standard, with appropriate impose withstand test voltage and power frequency withstand test voltage values.

The insulation levels for equipment's are as follows:

According to IEC rated service voltage : 11kV

Maximum service voltage shall be considered : 12kV

The respective test voltage shall be:

Impulse withstand test voltage (BIL) : 75kV

Power frequency withstand test voltage : 28 kV

For the lightning arrestor, the IEC standard voltage of 9kV is to be selected.

1.2.12 Technical Requirements

The equipment specified in the following items shall withstand the impulse levels and test voltages specified by the recommendations of IEC, as stipulated before. They must be capable of carrying the short time current for three seconds and must withstand the short circuit (Peak value) current.

The rupturing capacity of the circuit breakers is indicated in the respective items. The switchgear must be designed accordingly in order to withstand the mechanical short circuit stresses.

They must contain all technical particulars which are mentioned in the Schedule of Technical Data. The Owner reserves the right to have routine tests carried out on each type of equipment at the manufacturer's workshop in the presence of his representative.

1.2.13 High Tension Switchgear

The 11kV switchgear shall be pre-fabricated, complete and ready for erection and suitable for indoor installation.

11kV Switch Board shall be consisting of cubicles free standing type, for indoor installation, formed by pre-fabricated factory assembled. The individual cubicles shall be made of strong sheet steel (minimum 14 SWG) at all sides with iron angles and channels welded together.

The board shall be covered and the top shall be provided with pressure relief, flaps the bottom shall be open the allow connection of cables via and boxes, necessary holding iron and clamps are provided.

The front shall be provided with sheet steel doors with special locking devices and with viewing glasses in order to see the condition of the switches and the contact.

On the top of the cubicle a sheet steel enclosed relay, meter cabinet shall be provided.

Nominal System voltage	11 kV
Rated normal current	630A

Number of phases	3
Frequency	50 Hz
Rated short circuit breaking current (rms)	25kA
Rated short circuit making current duration	3 sec.
Rates short circuit making current	50kA
D.C component of rated short circuit breaking current	36%
Rated lightning impulse withstand voltage	75 kV
Rated Power frequency withstand Voltage (60 sec)	28 kV
No. of operation cycles at the Rated normal current	20,000
No. of operation cycles at the Rated short circuit current	100

The iron and sheet steel parts after cleaning by modern methods shall be painted in the initial layers and a final paint as such the lacquer shall be a protection against corrosion the tropical humidity. The single busbar system shall be of copper bars to withstand the required amperage. They are to be mounted on cast resin insulators in each cubicle. Busbar dimensions should be mentioned and purity of copper not less than 98% and conductivity 100%.The single bars shall be marked by the colors as per IEC, VDE or BS standard.

1.2.14 **Current Transformer (C.T.)**

The C.T. should be cast resin insulated with class 10P10 for protection and class 0.5 for metering. The rated over current factor and burden should be matching with operating burden of the connected equipment to prevent the instruments from being damaged, 1th = 80xIn, id = 200 In.

1.2.15 **Potential Transformer (P.T.)**

The P.T. should be cast resin insulated with appropriate accuracy class and burden minimum 50VA. The P.T. secondary shall be protected with MCB.

1.2.16 **IDMT Relay**

The relay for over current and earth fault protection should be of solid state (micro-computer operated) type. The complete triple pole, solid state IDMT relay with adjustable minimum setting for over current earth fault and short circuit protection including the A.C./D.C. converter.

This module can be housed in a standard case for assembling in cubicles. The socket which are located in either the rack or the case in which the module is plugged, should have one screw and one snap-on terminal each for the plant connections. The heavy duty current plug connector should be provided automatic shorting of the C.T. circuits whenever the module is withdrawn. A make-before-break earth contact should be there to ensure protective earthing, before the other plug connections can be made. The relay should be suitable for D.C. shunt tripping to be operated by 110V D.C. voltage from P.T. secondary through a rectifier or 12/24V d.c. through capacitor rectifier circuit.

Wiring inside the cubicles shall be minimum 1.5mm^2 area and with tinned copper conductors. Current circuits shall be made with minimum 2.5mm^2 area and with tinned copper conductors.

All cubicles, frames, transformers, measuring and relay circuits shall have protective earthing. Each cubicle shall be provided with earthing bolt and earthing parts. The bus bars shall be of copper and fully insulated through their length. The protection system shall consist of over current protection and earth fault protection.

1.2.17 **Three Phase Power Transformer**

The Transformer shall be from manufacturer having ISO 9001 and the general specifications will be as follows-

Dry type cast resin, natural air cooled, 3-phase, 50Hz, 1500kVA, 11/0.415 kV & 0.24 kV indoor type distribution transformer of Dyn11 vector group having basic impulse insulation level 75 kV, HV & LV bushings, manual 5 position standard tap changer, complete with two windings of high conductivity aluminum foil with insulation material in class H, earthing terminals, temperature sensor with thermometer, thermostat controlled blower fan (if required), lifting lugs, data plate etc. complete as required with maximum 60ºC temperature rise and suitable for operation at 40ºC ambient temperature, at 75°C full load loss & impedance condition manufactured & type tested as per NEMA / IEC / VDE / BS / JIS standard along with BDS IEC 60076, PART 1: 2016 standards.

Cast resin Indoor DRY Type Power Transformer-

Rated capacity	1500 kVA
Rated frequency	50 Hz
Rated primary voltage	11 kV
Rated secondary voltage	0.415kV

Tap changing	+/-2.5%. +/- 5%
Vector Group	Dyn 11
L.V. neutral	Brought out
BIL level (HT side)	75kV (HT side)
No load loss	2800 watts (maximum)
Full load loss	13500 watts (maximum)
Percentage impedance	6% @ ±10% at 75ºC
Maximum system voltage	12kV (HT side), 0.5 kV (LT side)
Cooling	ANAF.
Radial fan	Radial fan with controller to increase the power rating.
Enclosure	IP21 in non-magnetic sheet steel
Conductor of transformer	Copper

1.2.18 **Testing of 1500 kVA Dry-type Transformer**

The purpose of the enclosure is to provide safety from live parts, protect and make the equipment suitable for indoor conditions, prevent ingress of foreign matters, rodents, snakes etc. The material of enclosure used is CRCA sheet steel MS. The complete structure is rigid and self-supporting. To remove heat from the transformer, its louver has sufficient heat dissipation capability in indoor condition through the year without any additional cooling arrangements. The degree of ingress protection should not be less than IP21 and fully enclosed type for indoor use.

a) Measurement of Turns Ratio
b) Vector Group Test
c) Measurement of Winding Resistance at 75ºC
d) Measurement of Insulation Resistance
e) Measurement of No-load Loss and No-Load Current
f) Measurement of Impedance Voltage and Load Loss at 75ºC
g) Power Frequency High Voltage Test
h) Test of Transformer Oil
i) Temperature Rise Test

1.2.19 **Enclosure for 1500kVA Dry-Type Transformer**

The purpose of the enclosure is to provide safety from live parts, protect and make the equipment suitable for indoor conditions, prevent ingress of foreign matters, rodents, snakes etc. The material of enclosure used is CRCA sheet steel MS. The complete structure is rigid and self-supporting. To remove heat from the transformer, its louver has sufficient heat

dissipation capability in indoor condition through the year without any additional cooling arrangements. The degree of ingress protection should not be less than IP21 and fully enclosed type for indoor use.

1.2.20 **Tenderer Data List**

The Tenderer shall furnish following data at 75^{o}C at the time of commissioning.

a) No load loss at rated voltage and frequency
b) Full load loss (including eddy current loss) at continuous rated current (50 c/s) and for winding at 40^{o}C temperature with the Changer in middle position.
c) Impedance voltage with tap changer at middle position.
d) Voltage drops referred to rated voltage at rated load with tap changer in middle position and at unit P.F.
e) Permissible maximum symmetric three phase short circuit current referred to rated current.
f) Rated no load current (RMS value referred to rated current).
g) Type of windings with conductor materials.
h) Class of insulation material.
i) Voltage regulation.
j) Temperature after continuous rated load at 40^{o}C ambient temperature.
k) In windings: Core.
l) one-minute double power frequency induced tests voltage applied to:
m) H.V. line terminal
n) L.V. line terminal
o) L.V. Neutral.
p) Impulse test voltage 1.2/50 micro second fully wave positive and negative polarity applied to:
q) H.V. line terminal
r) L.V. line terminal
s) L.V. Neutral
t) Winding of Iron core: Copper

1.2.21 **Low Tension Switchgear**

The Low-Tension Switchgear shall be pre-wired, free standing and conforming to relevant standard.

1.2.22 Switchgear Design

The switchgear shall be pre-fabricated, complete and ready for erection on the site.

The switchgear shall be totally enclosed. All line parts shall be adequately and efficiently protected against accidental touching.

The switchgear cubicles shall conform to relevant provisions of relevant standard and shall be adequate in all respect to accommodate the cables, switchgears, meters, cable terminations and inter connection as indicated in the schedule/specification/drawings and be with provided lockable doors. All apparatus and other components shall be easily accessible from the front as required for inspection, replacement and repair. The switch gear shall be of tropical design.

The switchgear shall conform to the following specifications:

Operating voltage	415V, 3-phase at 50 Hz.
Voltage system	Direct earth
Number of busbars	5 (L1, L2, L3, N and PE)
Rated current of busbars	As per single line diagram
Busbar materials	Copper
Degree of protection of Busbar chamber	Enclosed
Maximum protective current (Cos Q = 0.2, t=0.1 sec) of busbar	55kA
Maximum short time withstand current of bus bar	63kA
Maximum protective peak current of busbar	150 kA.
current of bus bar	150 kA.

All parts of the switchgear including apparatus shall be designed to withstand without being damaged, the mechanical and thermal, strain of this current or, where protected by circuit breaker, the interrupting current of the circuit breaker.

Outgoing cables shall be arranged in separate specious cable spaces.

Protective screens shall, as far as possible, be arranged between main busbars and cable space.Terminals for power cables shall be protected against accidental touching.Interior control wiring shall be accommodated in plastic conduits.Wiring inside the cubicles shall be

made with minimum 0.75mm2 area and with tinned copper conductors.The Switchgear shall be suitable for bus bar entry from the top, if required as per schedule.

1.2.23 Apparatus

The switchgear shall be of modular type design. The apparatus of each functional group shall be assembled on a common base. Coils for bidders must be of open type to be repairable.

1.2.24 Cubicle Construction

The distribution sections shall be of car case construction and the car case shall be augmented with various cladding plates as required. The top plate, bottom plate and side plates shall be polled for easy removal.

The electrical equipment inside the panel shall be finger proof. The cubical shall be dust vermin proof. Exhaust and ventilation system, Busbar separator etc.

1.2.25 Cable Entries and Terminations

The distribution board shall be so designed that the cable is fed in and connected in the base. The bottom plate shall be split and removable type to facilitate cable entry having cable grommet.

All cable sockets for incoming and outgoing cable are to be provided.

1.2.26 Current Transformers

All current transformers shall comply with relevant standard and shall be of suitable class, rating and accuracy depending on the duty.

1.2.27 Indicating Lamps

Panels shall have indicating lamps.

1.2.28 Air-Circuit Breakers

The air-circuit breakers shall comply with relevant standard. The breaker shall have spring assisted manual closing mechanism with, breaker closing speed independent of operator. There shall be breaker closed opened position indicator manual tripping shall be by push button and it shall not be possible to trip the breaker by means of the closing mechanism. Over load release shall trip the breaker by means of the closing mechanism. Over load release shall trip the breaker on over current or short circuit. The time lag for these released and the current setting shall be adjustable. The breaker shall be interlocked to prevent access to live parts unless these circuit are in demand.

1.2.29 Miniature and Molded Case Circuit Breakers

The MCB/MCCB's shall be quick-make, quick-break, trip free, indicating type and shall have inverse time limit characteristics with adjustable overload, adjustable short circuit (the maximum adjustable limit should be as per schedule) and instantaneous magnetic trip elements functioning on overloads above the normal operating range. All circuit breakers shall be in accordance with schedule. All lugs must be of the solder-less above the normal operating range. The MCB must comply with rated voltage 240/415V, A.C. 50 Hz. interrupting capacities minimum 10kA, current limiting class 3, finger proof, protection through Thermal and Magnetic Trip sections respectively, temperature rating 40^{o}C preferably tropicalized (moisture fungus corrosion treated), with contacts of silver alloy, terminal capability as per requirement. The MCCB must comply with rated voltage 600V AC. 50 Hz with thermal overload and instantaneous magnetic tripping action, temperature rating 40 deg. C preferably tropicalized (moisture-fungus-corrosion treated), terminal capability as per requirement. The bidder may offer MCCB instead of MCB to meet requirement of the specifications.

1.3 LOW VOLTAGE AC SURGE PROTECTION FOR LT PANELS

1.3.1 Scope

The Bidder shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panel boards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in.

1.3.2 References

SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards.

1.3.3 Qualifications

a) The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

b) For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

c) The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer/ PIT, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

d) The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.3.4 Operation and Maintenance Manuals

Operation and maintenance manuals shall be provided with each SPD shipped.

1.3.5 Surge Suppression - General

Electrical Requirements

a) Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

b) Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.

c) The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

d) Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●

e) Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA in rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

f) ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) for the device shall not exceed the following-

Modes	208Y/120	480Y/277
L-N; L-G; N-G	700	1200
L-L	1200	2000

1.3.6 **SPD Design**

i. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

ii. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

iii. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

iv. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

v. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

a) Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

i. For WYE configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes.Wye configured units shall also contain an additional green /

red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b) Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c) Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d) Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter’s display prior to the interruption shall be stored in non-volatile memory and displayed after power

is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

1.3.7 **Over Current Protection**

a) The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve over current protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

b) Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

1.3.8 **Safety Requirements**

a) The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b) SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

c) Side mount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Side mount SPDs shall have factory installed phase, neutral, ground and remote status contact conductor's factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

1.3.9 **System Application**

a) The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and

switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environment.

b) Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table-

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations	160 kA	85 kA

c) SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs.

1.4 AUTOMATIC REACTIVE POWER CONTROL EQUIPMENT WITH CAPACITOR BANK

The Power Factor Improvement Plant shall be sheet steel clad dust and vermin proof free standing, floor mounting indoor type. The centrally controlled automatic PFI Plant will be of compact design and will be suitable for operation in 12 steps in the system for automatic control of the reactive power. The PFI plant shall be consisting of900kVAR, 415 volt, 3 phase, 50 Hz power factor improvement panel complete with TP bus bars and earth block, microprocessor controlled auto power factor correction relay with digital PF reading display, capacitor bank, contactor, fuse, ON indicators for every stage of capacitor bank (except directly connected one) etc. shall be manufactured & tested as per NEMA / VDE / IEC / JIS / BS standards along with relevant BDS standard assembled locally in 16 SWG sheet steel clad dust & vermin proof, free standing, floor mounting, epoxy resin powder coat painted cabinet as per relevant IEC standards and as per accepted / approved by the Engineer-in-charge. Assembled by the valid ISO-9001 certified company having test certificate (within five years) according to relevant IEC standards from BUET /RUET/ CUET / KUET /DUET/ MIST. 3 Nos. - 415V, 1500A hard drawn electrolytic copper bus bar.

1 No. - 415V, 25 kVAR, 50 Hz TP power capacitor bank with built in / separate discharge coil for connection directly with line through fuse.

3 Nos.-415V, 25 kVAR, 50 Hz TP power capacitor bank with built in / separate discharge resistor.

4 Nos. - 415V, 50 kVAR, 50 Hz TP power capacitor bank with built in / separate discharge resistor.

6 Nos. - 415V, 100 kVAR, 50 Hz TP power capacitor bank with built in / separate discharge resistor.

3 Nos. - 415V, 40 A 50 Hz auto TP magnetic contactor with AC3 duty.

4 Nos. - 415V, 80 A 50 Hz auto TP magnetic contactor with AC3 duty.

6 Nos. - 415V, 160 A 50 Hz auto TP magnetic contactor with AC3 duty.

12 Nos. - 415V, 50 A HR.C fuse with base.

12 Nos. - 415V, 100 A HR.C fuse with base.

18 Nos. - 415V, 200 A HR.C fuse with base.

The contactors shall have special non-welding contacts which can control inrush current of upto 1.80 times the rated current. When the contactors drop out the resistors shall be switched on the capacitor by means of two break contact. The contactors shall be conforming to having: i. Minimum life span of 0.1x106 operations, ii. Minimum operating frequency of 120 ops/hr., iii. Making capacity (i-peak value) without damping 1.80 times Ie and the contactor shall have early make auxiliary contacts fitted with resistors for pre-charging of capacities to reduce the inrush current. The control unit shall be an integral part of the PFI Plant and will be comprised of C.T. of adequate rating automatic power factor correction relay to keep the automatic power indicating lamp ON/OFF switches, switching step indicator etc. The automatic control must be non-responsive in a certain range to element hunting.

1.5 INSTALLATION

1.5.1 HT Gear and Metering Panel

All standard checks of the equipment before installation shall be done by the Bidder and unit shall be installed and tested as per direction of the manufacturer and Engineer/ PIT/Consultants. Required finishing work shall be done by the Bidder and hooking up the unit with the system shall also be within this contract. Consumable materials required for complete installation of the equipment including cables compound, boxes etc. shall be supplied by the Bidder. After complete installation be unit shall be tested by the Bidder upto the satisfaction of the Consultant and the Engineer/ PIT. All final approval will be done by the Owner/Engineer/ PIT.

All accessories shall be installed as per direction of the Manufacturer and the Engineer/ PIT/Consultants. If the equipment is damaged during handling and installation. The Bidder must repair the damage or replace the damaged parts at his own cost.

1.5.2 Transformer

The Transformer equipment's should be checked before installation by the Bidder and installed and tested as per direction of the Manufacturer and Consulting Engineers/ PIT.

Required finishing work shall be done by the Bidder and hooking up the transformer with the system shall also be within this contract. Consumable materials required for complete installation including cable compound boxes etc. shall be supplied by the Bidder and the rate quoted shall be inclusive of all incidental expenses. Care should be taken during carrying the transformer and its related parts. If there is any damage during handling and installation the Bidder will be liable to replace the damaged parts at his own expenses. After complete installation the transformer must be tested and commissioning as per direction of the Engineer/ PIT, Manufacturer and Consultant.

1.5.3 LT Switchgear

All LT Gear equipment must be installed on proper foundation. All consumables required for the complete work shall be supplied by the Bidder. The work shall be complete with all internal electrical connections. After complete installation of the panel the Bidder should test the complete LT switchgear equipment as per manufacturer specification and direction for full satisfaction of the Consultant and Engineer/ PIT.

1.5.4 Capacitor

The item includes supervision of installation of capacitor on prepared foundation. The foundation is to be prepared by Bidder as per direction of the Engineer/ PIT/Consultant. All consumables required to install the equipment shall be supplied by the Bidder. After completion of the installation the Bidder should test the equipment in presence of Engineer/ PIT/Consultant to his satisfaction.

1.6 HT/LT CABLE AND TRAY

1.6.1 HT Cable

Multi core cable of copper with PVC insulation, field limiting conducting layers over each individual conductor and core and also over each individual core. PVC inner sheath cover common covering of cores, flat steel wire armoring helical steel taping and PVC outer sheath direct burial types, termite proof, made and tested according to VDE 0271/3.68, VDE

0472/6.65 and VDE 0472/3.69for this type of installation rated voltage being 5.8/12.00 kV. 3x240 sq.mm N2xSEYFGbY cable will be used as electrical cable from 11kV feeder to 1500kVA transformer.

1.6.2 LT Cable

Multi-core low voltage cables shall be PVC insulated, PVC sheathed non-armored, fire retarded low smoke zero halogen, direct burial type, termite proof, made and tested according to VDE 0472/6.65 and VDE 0472/3.69 for this type of installation rated voltage being 600/1000V.

1.6.3 Testing of LT & HT cable

a) Dimensional Test
b) DC Resistance Test IEC 61935-1
c) Insulation Resistance Test IEC 60060-1
d) Current carrying capacity Test IEC 60287
e) AC high voltage withstand test IEC 60079

1.6.4 Cable Trench

The size of the trench shall be of minimum 825mm (2'-9") depth and 450mm(1'-6") width for each cable to be laid. Where more than one cable is to be laid in the trench, the width of the trenches is to be increased by 150mm (6") for each extra cable for size below 70mm^2 (3and1/2 core or 4 core) and 305mm (12") for bigger size cables.

A cushion of sand of F.M. 1.5, 125mm (5") thick is to be placed over the bed of the trench over which the cables are to be laid.

After laying the cable first class brick on edge of flat are to be placed as separators in between the cables. After installation of the brick separators, sand filling is to be done upto 150mm (6") from the top of the bigger cable. After sand filling, two layers of first-class brick flats are to be placed along the length and breadth of the trench as a protection against injury and indication that a power cable is laid. The rest of the trench shall be filled with earth, watered and rammed at 150mm (6") layers. After cables are laid the original ground conditions shall be restored. But if brick pavement, drain, concrete road, or bituminous carpeting road are out across or damaged, they shall be remedied and restored to the original specification.

The cable route shall be as direct as possible and shall receive the Owner/ consultants/Engineer/ PIT approval before excavation.

All cable bends shall have a radius of not less than 2 times the diameter of the cable drum, or 20 times the diameter of the cable whichever is greater.

G.I. pipe shall be provided for all road and drain crossing. These pipes shall be laid direct in the ground without any sand bed, sand layer, brick or cable covers.

Cables shall always be laid out or laid into the ground through G.I. pipe of suitable size as decided by the Engineer/ PIT/Consultant the length of the pipes over the ground shall not be less than 1200mm (4'-0"). No extra cost shall be paid for such pipes. The exposed end of the pipes shall be sealed using PVC or wooden plugs.

The Bidder shall exercise great care in handling the cable and avoid forming 'KINKS'. The cable drums shall preferably by conveyed on wheeled cable drum carried and unrolled and laid directly from the drum carrier. Carriage by trailer or truck can be allowed only if proper care is taken during unloading the drum, and unrolling is done after placing the drum or drum jacks and spindle. The cables shall be unrolled in the directions indicated on the drum by the manufacturer. G.I. cable marker is to be supplied and installed at every turning point of the trench.

After the cable is laid, it shall be tested by the indicated placed by the supplier at his own cost. No extra charge shall be allowed for this.

Any damage done to any other services by the Bidder for cable laying operations, shall be made good by the Bidder.

All chasing and passages necessary for laying of cable indoor shall be done by the Bidder and the same shall be made good to the satisfaction of the Consultant by the Bidder without any extra charge to the Owner.

Whenever trenches are left open at overnight, and where road is to be cut, the Bidder shall exhibit suitable danger signal such as banners, red flags and red lamps at his own cost. Temporary arrangement by placing wooden sleepers/sheet steel etc. across the road cutting for vehicular traffic are also be made by the Bidder at no extra cost. The Bidder shall be wholly responsible for any accident which may occur due to the negligence of the Bidder. Above the sand filling red marking tape should be laid.

All road excavations shall be filled up in layers with power earth and suitably watered and rammed in such a manner that after completion of the work there is no land subsidence. The road top shall be reconstructed to match the existing road pavement

No trench shall be dug until all cables meant for laying have been procured and brought at site store. Cost of any re-entering or shuttering and showing of trench required to be done shall be borne by the Bidder.

1.6.5 Cable Pit

As per open yard conduit layout cable pit must be kept as shown for drawing LT low voltage power cable. All cable pit will be covered by RCC cover with lifting lugs arrangement.

1.6.6 Insulation Test

Insulation test of the whole installation shall be carried out using Meggar, in presence of authorized representative of the Owner/Consultant/Engineer/ PIT, and result submitted to the Owner for approval

The Bidder shall conduct the following tests with the help of the concerned department/authority and the costs of performing the tests should be included in the quoted rates-

a) Megger test report of transformer, MCCB, load break isolators, P.T., C.T.and cable etc.

b) Insulation test report

c) Earth test report and the certificate to be obtained from the Chief Inspector, Govt. of Bangladesh.

d) The necessary approval certificate of proper installation to be obtained from Electrical License Authority.

e) Testing, commissioning and sealing of kVAH, kWHr, etc. meters from the concerned office of PDB.

f) Testing of C.T.B. measuring, protection and signaling circuits by the concerned office of PDB.

1.7 EARTHING SYSTEM

The work under this item shall consist of supply and installation of earth electrode with copper lead, earthing inspection pit and connecting to the specified terminal according to the drawing, specification and direction of the Engineer/ PIT. The whole electrical system

including light, fan, regulator sockets sub-station and metal parts incorporated with facility electrification shall be earthed.

The earth resistance of the electrodes system shall be to the satisfaction of the local supply authority and shall not exceed in one Ohms. Voltage to Earth divided by 5 into Current rating of the largest over Current protective device.

1.7.1 Materials

1.7.1.1 Earth electrode

The earth Electrode in a 38mm (1.5") dia, sunk down to a depthto attain a earth resistance of minimum 1(one) Ohm (for each electrode) with Ø5mm drilled holes. The G.I. pipe shall be similar to the specification.

The pipe earth electrode shall be sunk and buried below ground level upto its full length or as advise by the Engineer/ PIT. The earth lead and be connected to the earth electrode by brass/G.I. clamp. After making connection the clamp shall be covered with bitumen poured hot and with jute cloths.

1.7.1.2 Earth lead

Earth lead shall consist of two numbers, 2x2/0 SWG high conductive electrolytic bare copper wire meeting the requirement of B.S.S. 6360: 1969 and/or it's equivalent.

All earth lead shall follow the shortest and most direct route to the earth electrode avoiding sharp bend and from inspection pit to the entry at the facility shall be enclosed in Ø25mm G.I. pipe. The earth lead shall be connected to test earth electrodes by means of lugs, bolts, nuts and double washers to fixed as to make permanent and positive connections both electrically and mechanically. The joints shall be covered with PVC compound without disrupting the continuity.

1.7.1.3 Earth inspection pit

Inspection pit shall have to be constructed over earth electrode to inspect and test the connection terminals. Bricks used shall be of 1st class and only approved quality cement shall be used, Jhama brick khoa for R.C.C. cover shall be 19mm inch downgraded and washed, cleaned before casting. Ø10mm M.S. Rods @ 100mm c/c with two Ø12.7mm M.S. Hook shall be provided in the cover slab.

1.7.2 **Installation**

1.7.2.1 **Electrode**

The pipe earth electrode shall be sunk and buried below ground level upto its full length or as devised by the Engineer/ PIT. The earth leads shall be connected to the earth electrode by silicon aluminum bronze body clamp and phosphor bronze screws. After making connection the clamp shall be covered with bitumen poured hot and with jute cloth.

1.7.2.2 **Lead**

All earth lead shall follow the shortest an most direct route to the earth electrode avoiding sharp bend and from inspection pit to the earth electrode avoiding sharp bend and from inspection pit to the entry at the facility shall be enclosed in Ø25mm water grade PVC pipe. The earth lead shall be connected test earth electrodes by means of lugs, bolts, nuts and double washers of failed as to make permanent and positive connections both electrically and mechanically. The joints shall be covered with PVC compound without disrupting the continuity.

1.7.2.3 **Pit**

1st class brick made inspection pit and RCC cover with lift hook shall be built on earth electrode as described here above at the location shown on the drawings the electrode shall be within 10’-0” from the facility.

1.8 **LIGHTNING PROTECTION SYSTEM**

Whole operation area of slipway and winch will be under lightning protection by the digital early streamer system and will be placed on top of **HIGH MAST POLE**. At least 4 set of this lightning protection system will be installed for overall thunder protection. Supply,installation, testing, and commissioning of digital early streamer emission air terminal (ESEAT) base of collection volume (CVM) as per IEEE 998-2012 having the following technical specification-

1.8.1 **Main features**

a) This must be integrated with High Mast Pole as the highest elevated point.

b) Withstand peak lightning current: 100kA

c) Weather condition of work:Making of lightning air terminal should be able to work in any environmental condition. So, material of air terminal should be stainless steel

d) Dimension of air terminal: Minimum length: 220mm, Ø25mm, solid rod at the bottom of the air terminal having M20 male thread to fix on mast.

e) Certified advance time: Maximum 60µ second with a current peak higher than 100ka

f) Material of the air terminal: Stainless steel

g) Weight: 2.25-2.5kg

h) Radius of protection: 90-100 meter at 5-meter height from the plan

i) System should be compliant to UL-96, Lightning protection component standard of safety.

j) Brand: ABB/LPI/ERICO, Model: ABB OPR 60/ LPI CAT ii-G / ERICO DYNASPHERE or equivalent

k) Manufactured and made in: USA/FRANCE/AUSTRALIA or other EU countries.

1.8.2 Air Terminal Mast

Insulated Air terminal mast of the following specification. Made of stainless steel (Type- 316), Length: 2300mm, dia: 30mm. The mast shall be fixed on the top of the GI tower with SS nuts bolts, clamps as per sample approved by the engineer/ PIT. Supply and installation of lightning event counter of the following technical specification: Register capacity: 0-999 mechanical counting without external power supply (LCD display). The down conductor shall pass the whole of the counter and the same shall be fixed vertically at any point. Supply and installation of earth test box with the following arrangement inside it.

1.8.3 Test Joint

79mm X 50mm X 20mm, made of copper, 30mm X 2mm andDia 8mm line coupling, made of copper

1.8.4 Down Conductor

Supply and drawing of copper made down conductor having DIA 12.7mm or copper strip 30mm x 2mm with fixing holder on vertical and horizontal surface. The fixing clamp shall have 40mm to 50mm length or height and will be placed 3nos/ meter as per direction and sample approved by the engineer/ PIT.

1.8.5 Chemical Earthing

Construction of earthing (2 nos) for the lightning arrester as per instruction and enclosed Diagram of the engineer/ PIT in the following way-

i. Soil digging: 3000mm X 400mm X 400mm (2 nos)

ii. Construction of pit by bricks and RCC slab on it. On the top of the slab there will be a hole and a pit cover made by cast iron will be fix on it. Size of the pitwill be 600mm X 600mm X 600mm (2 no’s)

iii. Copper plate: 300mm X 150mm X 15mm (2 no’s). Copper plate will be fixed with the electrode by necessary fixing material made of copper.

iv. Copper electrodeDIA 12.7mm or copper strip 30mm x 2mm. Length of the copper or strip minimum (10+10) = 20meter in total

v. Ground enhancing material (40+40)= 80kg, 2 no’s dedicated earthing will be considered 1 set.

CHAPTER 2 EMERGENCY GENERATOR

2.1 GENERAL OVERVIEW

2 no's DIESEL ENGINE Driven A.C. generator with synchronizer set for parallel operation should be rated as 300kVA Prime Power and output voltage 400/230V, 3 Phase, 4 Wire, 0.8 PF, 50Hz. Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN6271 and BS 5514. The Generator must have Standard set-mounted radiator cooling Ambient Design must be 50ºC. The Generator must be manufactured in facilities certified to ISO9001 or ISO9002. The generator set must have ''The Power Command™ Control''-which is microprocessor-based generator set monitoring and control system. The generator set mounted control must provide an operator interface to the generator sets, digital voltage regulation, digital governing and generator set protective functions and Power Command Digital Paralleling Control. Two unit 300kVA/240kW (Prime power) at 0.8 PF with auto starter and auto transfer switch and all other accessories will be installed in ground floor of winch control and operation facility.

2.1.1 General Instructions

The engine and alternator assembly shall be directly flanged coupled; the alternator being driven by a flexible coupling connecting engine fly wheel to alternator rotor.

The unit should be mounted together with cooling radiator on a fabricated, heavy steel frame of all welded construction designed to accurately align and support the assembly. The base frame is to be predrilled to allow for anti-vibration mounts and is to be provided with special lifting arrangement for case of handling and safety purposes.

There must be arrangement for manual/ automatic battery electric start being operated from the main control panel which shall also include all monitoring and protection devices covering the mechanical and electrical systems.

2.1.2 TECHNICAL DATA CHART for 300kVA (PRIME POWER) GENERATORS

Generator Brand (Prime Mover)	Wartsilla (Finland), Caterpillar (USA),Scania (Sweden), SEMT Pielstick (France),

	MAN(Germany), MTU (Germany), Moteurs Baudouin (France)
Alternator Brand	Leroy Somar (France), Stamford (UK)
Generating set Model	To be proposed by bidder
Alternator Set model	To be proposed by bidder
Manufacturer's Name	To be proposed by bidder
Country of origin	Germany, USA, France, UK.
Country of manufacture	Germany, USA, France, UK
Number of units	2 no's, running in parallel mode with synchronizer
Generator Capacity Prime	300kVA, 240kW at 0.8 P. F
Supply System	3-phase, 4-wire,400/230V, 0.8 pf
Frequency	50Hz
RPM	1500 rpm (50Hz)
Ambient Temperature	40^{O}C (Radiator 50°C)
Overall Dimensions (mm)(Open)	To be proposed
Dry/Wet Weight (kg)(Open)	To be proposed
Maximum load acceptance Single step	100%, to be proposed at ±1% Voltage drop and4.5% speed drop
Single load step to NFPA110	100-110% load taken during emergency power system, meets all requirements for level 1system
Base Fuel Tank	Base fuel tank of sheet steel construction fitted with large filler cap with breather, supply and return pipes float level gauge and drain plug for 8-10 hours operation
3-D Operation Fuel Tank	Main storage fuel tank for three days' operation,

	daily fuel tank and made of sheet steel minimum thickness of 12 SWG and all other accessories as per specification and direction of the Engineer/ PIT.

2.1.3 DIESEL ENGINE

Engine Model	To be mentioned
Manufacturer's name	To be mentioned
Country of origin	UK/USA/Germany/France/ Finland/ Sweden
Number of cylinders and arrangement	Minimum 6 Cylinder Diesel, 4 cycles, 400 Vee, Turbo charged and After cooled
Governor Type	Isochronous Electronic Governing Controls engine speed within plus or minus 0.25% for any steady state load from no load to full load. Frequency drift will not exceed ±0.5% for a 60°F (33) change in ambient temperature over an 8-hour period and have facilities for droop Governing, Temperature Dynamics, Idle mode, Isochronous (kW) load sharing control, Droop load sharing control.
Speed	1500 rpm
Bore stroke (mm)	To be proposed
Displacement (cc)	To be proposed
Compression ratio	To be proposed
Fuel System	To be proposed
Fuel Consumption	Load %100% 75% 50% 25%
Fuel consumption (Liter/ Hr.)	To be proposed
Maximum engine output according to DIN (HP/RPM)	To be proposed
Weight of engine, dry and Wet (kg)	To be proposed
Starting device	Self-starter Motor with 24V Battery with charging Dynamo (35A) with Auto charger

Cooling system (Radiator)	Circulated by a centrifugal pump with 500℃ tropical radiator and blower fan.
Exhaust Silencer	Residential type Silencer.
Lubrication system	To be mention
Literature and illustrations	Enclosed
Engine Low NOX Emission treatment /Emissions Certification	This engine complies with certain emissions requirements established by US EPA, data as follows and data sheet is enclosed
Heavy duty Air Cleaner	Will be fitted with engine for Dust free and longer life

2.1.4 **ALTERNATOR**

Alternator Model	To be proposed
Manufacturer's name	To be proposed
Country of origin	UK/USA/Germany/France/ Finland/ Sweden
Number of unit	2 no’s, running in parallel mode
Prime Power	300 kVA (prime)
RPM	1500 (Clockwise)
Power Factor	0.8
Voltage	400V/ 230V-415V/ 240V
Frequency	50Hz
Voltage Regulation	within ±0.5%
Class of Insulation	Class H, IP23 Protection
Weight of alternator (kg)	To be proposed
Guaranteed efficiency under 1/2, 3/4 and full load at 0.8 and unity power factor	94.9%
Automatic Voltage Regulator (AVR)	Microprocessor based system have integrated automatic voltage regulator, output within ±1.0%

2.2 DETAILED SPECIFICATION

Diesel engine driven generating set having a continuous rated output at 0.8 Power factor at 415/230 Volts, 3-phase, 4-wire, 50Hz at 1500 RPM under conditions of normal temperatures and pressures with 10% overload for one hour at conditions specified under B.S. 5514, DIN6271, ISO 3046 / 1.

2.2.1 ENGINE

Diesel engine driven generating set having a continuous rated output at 0.8 Power factor at 415/230 Volts, 3-phase, 4-wire, 50Hz at 1500 RPM under conditions of normal temperatures and pressures with 10% overload for one hour at conditions specified under B.S. 5514, DIN6271, ISO 3046/1.

The engine shall be complete with close control governing to BS 5514, 1979 Class A1 Fuel Injection equipment with:

a) Fuel oil filters

b) Lubricating oil filters

c) Air cleaners/filters

d) Fuel solenoid energized to run,

e) Lubricating oil pressure pump,

f) Water circulating pump,

g) Battery charging generator,

h) Precision governor,

i) Starter motor,

j) Fuel solenoid

k) Thermostatically controlled by pass system

2.2.2 ENGINE STARTING

The engine shall be fitted with manual automatic electric starting by means of a starter motor arranged to engage with the fly wheel.

2.2.3 LOADING CONDITION

The AC Generator set will be subjected to sudden high inductive loads like 3 phases induction motor not more than 60 KW where starting transient current will be very high.

Under such circumstances, the output voltage should remain sufficiently stable the generator must be capable to undertake maximum load at both 50Hz and 60Hz frequency. The Governor and AVR system must be highly responsive and should meet the following conditions:

(1) Voltage:

(a) Voltage transient tolerance: +25% to 20%

(b) Voltage transient recovery time: 06 sec (for the voltagelevel to recover to within ±5% of the original value)

(2) Frequency

(a) Frequency transient tolerance: Upto +12% to -10%

(b) Frequency transient recovery time: 05 sec (for the frequency level to recover to within +3% of the original value).

2.2.4 ENGINE COOLING

The diesel engine shall be cooled viaa tropical air blast heavy duty radiator with engine driven pusher type fan, complete with water circulating pump, radiator guard, thermostat and by pass system.

2.2.5 BATTERIES

The unit shall be supplied with a set of suitably rated heavy duty 12/24-volt industrial type lead acid batteries (dry charged). A mains operated battery charger should be mounted in control cubicle. A set of starter cables and connections would be supplied loose.

2.2.6 LUBRICATING SYSTEM

Wet sump force feed lubrication system by gear driven oil pump incorporating replaceable oil filters.

2.2.7 EXHAUST SYSTEM

The engine shall be supplied with: -

Acoustic type silencers, flexible bellows sections and rigid exhaust pipe of suitable length, suitable for use with Vee form engine, supplied loose for site erection. The complete exhaust system shall be designed to prevent any de-rate of the engine due to excessive back pressure. All exhaust components are to be finished with heat resistant paint.

2.2.8 ALTERNATOR

Brushless Salient pole rotating field, self-exciting, self-regulating, single bearing construction with integral automatic voltage regulator providing voltage control to within +/- 2% of nominal range, no load to full load and at all power factors between unity and 0.8 lagging and with a maximum 5% prime mover speed variation.

Class H insulating on both rotor and stator windings and with enclosures to IP21 of BS 4999 Part 20, IEC & DIN standards. The alternator meets the requirement of BS 5000 and radio suppression to BS 800 & VDE class G&N.

2.2.9 ANTI-VIBRATION MOUNTINGS

A set of anti-vibration mounts and spring isolator would be supplied loose for positioning beneath bed frame when the side is delivered to site. These should have their own in - built leveling device and friction pad, therefore fixing to the floor is not necessary.

2.2.10 FUEL SYSTEM

The unit shall be supplied with a base mounted fuel tank in corporate in the base frame of the unit providing sufficient fuel for 8 hours' continuous full load operation, the base shall be pressure tested prior to assembly and will incorporation dial type content/gauge, filler cap, vent pipe, drain cock and all necessary fuel connections. All pipe terminations shall be completed during works assembly. The system shall include arrangement for low- and high-level alarm system of fuel. An additional daily fuel tank (self-standing)1500-liter capacity with automatic supply type including level switch & pump.

2.2.11 FUEL TRANSFER

A set of rotary type hand pump would be supplied with 3 meters of flexible pipe, suitable for manual fuel transfer to the daily service fuel tank.

2.2.12 COUPLING

The alternator casing would be flange mounted to the engine flywheel housing and the rotor shaft, coupled to the engine flywheel through a flexible element to minimize torsional vibration throughout the operating range.

2.2.13 BASE FRAME

The engine and alternator would be mounted on a fabricated steel type base frame of welded construction adequately designed to resist bending and torsional forces. The base

frame shall accurately align and support the assembly and shall provide Sub-Station & Diesel Generator Set setting points and location points for securing to the foundation.

2.2.14 ENGINE INSTRUMENTATION

Incorporated in the control panel or mounted on a separate engine mounted panel, our option, shall be the following engine instrumentation: -

1-Oil Pressure gauge.

1-Water Temperature gauge.

1-Hours run recorder.

2.2.15 BONNET & SOUND PROOF CANOPY

Should be fabricated by heavy duty steel structure covering with steel sheet. The inner side of the steel enclosure should be lined with sound absorbing materials which should be covered by perforated steel sheet. The sound reducing level should be 82 dBA @ 1 meter from the canopy.

2.2.16 GENERATING SET PROTECTION

The unit shall be arranged to automatically shut down and indicate the same in the event of:

a) Fail to start

b) Low oil pressure

c) High engine temperature

d) Engine over speed

e) Overload

f) Over/under voltage protection

2.2.17 FINISH

The generating set would be finished in Hammer blue/Yellow and the control panel in grey/Yellow.

2.2.18 HAND BOOKS

The equipment would be supplied with:

i. Operation & maintenance manual.

ii. Engine & alternator parts catalogue."

2.2.19 TOOLS

One set of standard routine maintenance tools would be supplied in a tool box.

2.3 FREQUENCY CONVERTER

1unit 400 kVA frequency converter or above/ less capacity as per requirement of repair facility, should be provided at open repair facility setting is typically designed to frequency converter to-ship power conversion, harmonizing the frequency and voltage between the ship and the local utility grid. Here are the key technical details, features, and configurations to consider for a unit suited to marine and offshore applications:

2.3.1 Purpose and Application

a) Converts shore power (e.g., 50 Hz grid) to ship-compatible power (e.g., 60 Hz or vice versa).

b) Ensures seamless energy transfer between land-based utilities and onboard ship systems.

c) Supports marine vessels, naval ships, cruise liners, and offshore platforms.

2.3.2 Key Technical Specifications (Typical for 400 kVA Unit)

Parameter	Value / Range
Power Rating	400 kVA
Input Voltage	400 V / 3-phase / 50 Hz (grid supply)
Output Voltage	440 V or 480 V / 3-phase / 60 Hz (ship supply)
Output Frequency	60 Hz ± 0.01% (adjustable: 45–65 Hz)
Power Factor	≥ 0.98 (adjustable or auto-compensated)
Efficiency	≥ 95% at full load
Cooling Method	Forced air or optionally liquid-cooled
Harmonic Distortion	THD < 3% (output)
Enclosure Rating	IP54 or IP55 (for outdoor/marine use)
Standards Compliance	IEC 60092, IEEE 45, IEC 61892, DNV/ABS/GL

2.3.3 Protection Features

a) Overcurrent and short-circuit protection

b) Over/under voltage and frequency protection

c) Input and output phase loss detection

d) Thermal protection (IGBT, transformer, fans)

e) Ground fault and insulation monitoring

2.3.4 Marine-Grade Design Requirements

a) Corrosion-resistant cabinet and components (marine coatings, stainless steel)

b) Vibration-resistant mounting

c) EMC shielding to prevent interference with navigation or communication systems

d) Remote monitoring and diagnostics

e) Compatibility with PMS (Power Management System) on ships

2.3.5 Optional Features

a) Plug-and-play ship shore connection interface

b) Touchscreen HMI with fault history and real-time monitoring

c) Remote access via Modbus/TCP, Ethernet/IP

d) Black start capability

e) Battery backup for control circuits

f) Should be mounted near the berth or shore connection point

g) Foundation or vibration damping if using a rotary solution

h) Must be compatible with ship's protection and grounding scheme

2.4 SYNCHRONIZING PANEL WITH DIGITAL MASTER CONTROL

2.4.1 Main Features

Manufacturer's name	To be proposed
Generator Set Mounted Digital Control Panel	Power Control panel is a microprocessor-based generator set monitoring, metering and control system with auto start and auto synch. Facilities for Parallel Operation. True alternator over current protection. Digital governing and voltage regulation – Including digital over current fault regulation. Digital paralleling controls–Including

	synchronizing, load sharing, import/export controls, and other functions. True alternator over current protection. Analogue and digital AC output metering. Battery monitoring system - Senses and warns against a weak battery condition. Digital alarm and status message display. Generator set monitoring - Displays status of all critical engine and alternator generator set functions and includes sensor failure monitoring. Smart starting control system - Integrated fuel ramping to limit black smoke and frequency overshoot, in addition to optimized cold weather starting.
Sound Attenuated Enclosure (Room Canopy)	CSC Certified Standard 4-point lift with side ladder and fork slots Proper surface preparation with sound blast, primer and top coat Air Inlet filter All hardware including door, hinges and louvers are within the envelope of the Enclosure Heavy Duty Hardware and stainless-steel hinges Durable Metal flooring inside the enclosure Well Insulated exhaust silencer mounted inside the enclosure with rain cap Large louvered double access doors with removable dust filters; side door access Controller accessible from outside of the enclosure External topping points and drain points for fuel, oil and water Non-treated acoustic louver Sound level 75dBA @1m @100%load Sound level 60dBA @100%load outside the Generator room
Factory Test	0, 25, 50, 75, 100 and 110% load test will be done at factory before Shipment
Testing and commissioning at site	All tests will be done at site and recorded with available site load
All catalogues and Circuit Diagram	Enclosed and will be supplied with Generator Sets.

Generator Tool Box	For each generator by the bidder

2.4.2 Basic Function

Basic Function Start/Stop	Automatic
Synchronization	Automatic
Load Sharing	Automatic
Demand Control	Automatic
Load Shedding	Programmed

2.4.3 Operation Method

Start/Stop	Manual start on 1st Generator set or Automatic start in case of AMF system from 2nd set, Automatic start depend on load demand
Synchronization	Automatic action as follows
Tuning	Automatic operation
Voltage	Voltage timer (Fixed)
Frequency	Automatic by speed controller
Phase angle	Automatic by speed controller
Turn on MCCB	It can be turned on automatic ACB type is motorized
Load Sharing	Automatic control by controller
Demand Control	Automatic Start/Stop depend on load capacity
Load Shedding	Programmed and signal terminal is equipped

2.4.4 Control Circuit

Individual Panel	Control relay Circuit
Master Panel	PLC (Programmable Logic Controller).

2.4.5 Controller

Engine Speed	Electronic Actuator on Engine and speed controller
Synchronization	Automatic Synchronizer

Load Sharing	Automatic Load Sharing Unit
Demand Control	Load Sensing Unit

2.4.6 **Auto Load Device**

2.4.6.1 **Engine Panel:**

Control Module Unit	Auto start type with Mode selector switch and Alarm function
Alarm function on the Module Unit	Start fail
	Low oil Pressure
	High coolant Temperature
	Over Speed - E Charge Fail
	Mains Fail - E Utility
Gauge Meter	Gauge, Engine Coolant Temperature
	Gauge, Engine Oil Pressure
	Meter, Charging Meter
Push Button	Emergency Stop
	Manual Start, Engine
	Manual Stop, Engine

a. Function of Control Module Unit on Engine Panel

i. Mode Selector switch position and Function: Automatic start type

Position	Function
OFF, RESET	All function cannot be operated. All alarm holding condition can be cancelled at this position.
LAMP TEST	All light will light up for lamp test.
AUTO	The engine can be started automatically by outside signal.
	a. In case of the engine does not start at 1st

	cranking, cranking/stop action will be repeated maximum 3 times. b. When the engine still does not start after 3 attempts, "START FAIL" light on the Unit lights up. c. When auxiliary stop signal comes, the engine can be stopped automatically after cool down running
MANUAL	The engine can be started/stopped by auxiliary manual button.

ii. Auxiliary Switch

Manual Start Switch, Manual Stop Switch: For Manual operation.

2.4.6.2 **Individual Panel**

Panel Type	Self-Standing
Control System	Relay Control Circuit with MCB
Control Function	Automatic Synchronizing Control
	Automatic Load Sharing Control
	Automatic Load Demand Control
	Automatic Load Shedding Control
Meter	Voltmeter x1 and Phase Selector switch
	Ammeter x1 and Phase Selector switch
	kW (Kilo Watt) Meter
	Running Hour Meter
	Frequency Meter
	kWH meter
Control Device	Electronic Engine Speed Controller
	Automatic Synchronizer
	Automatic load Sharing Unit
	Load Sensor and Transducer
Power Line Contactor	Motorized ACB
Push Button	Emergency Stop
	Lamp test

	Alarm Muting
	Lead set
	ACB Close
	ACB Open
	Alarm Reset
Potentiometer	Potentiometer for Voltage
	Potentiometer for Engine speed
Selector Switch	Engine Duty/Standby Switch
	Mode (MAN/OFF/AUTO) Selector Switch
	Load Rise/Down Ramp Switch
	Engine Manual Start/Stop Switch
Indicating lamp	Phase indicating light
	ACB Close
Alarm Lamp	Over Current
	Earth Fault
	Reverse Power
	Engine Fault
	Over voltage
	Synchronizing Fault
Protection Device	Over Current
	Earth Fault
	Reverse Power
	Synchronizing
	Over voltage
Copper Bus bar	Incoming Bus bar
	Outgoing bus bar

2.4.6.3 **Master Panel:**

Panel Type	Self-standing
Control Circuit	PLC (Programmable Logic Controller)
Meter	Bus bar voltmeter x1 and phase Selector Switch Bus bar Frequency Meter Synchro scope
Lamp	Synchronizing Lamp x2 Standby to Start, Generator 1,2 and 3
Switch	Incoming Selector Switch Synchro scope Selector Switch Load Demand Selector Switch

2.5 **AUTO TRANSFER SWITCH (ATS)**

In Mongla project, we will need 1000A auto transfer switch for switching the electricity source from PDB to Generator.

Auto transfer switch will have both automatic and manual transfer operations for dual electricity supply source from BPDB & standby emergency diesel generator. Main cabinet of steel will be of 16SWG, indoor type, floor mounting low tension switchgear for 3-phase, 4 wire, 385/415V AC system. ATS unit will have TP+N+E busbar of suitable size to withstand a short circuit current of 25 to 50KA according to their rated capacity for 1sec. The ATS panel board are designed & constructed in accordance with BS, VDE, IEC standard. Main features are described below:

a. For main BPDB side: 1000A TPACB, 65KA, TP, 415V AC, variable type TPMACB including with compact control mechanism, Brand: Schneider/ABB

b. For Generator (secondary side): 1000A TPACB, 65KA, TP, 415V AC, variable type TPMCCB including with compact control mechanism, Brand: Schneider/ABB

c. Digital power meter (DPM) with display of operational measurement for Ampere and Voltage with phase selection, kWH, kVARh, kVAR, power factor and kW with MDI, Brand: Schneider

d. Auxiliary relay

e. 4x Phase indicating lamp (R, Y, B, N) for status

f. Digital timer with base 220V AC, 10A,

g. Relay with base 250V AC, 10A

h. UV/OV Relay Aux supply -380-415-440V AC

i. Selector switch 5A, 250V,

j. Main bus bar of suitable ampere rating according to ATS

k. Adequate rate link bus Circuit breaker

The supply and installation of generators with automatic change over switch shall be on "turnkey basis" and shall include the cost of:

a) Taking necessary permission from the relevant of authority.

b) All pipe works.

c) All inter connecting power and control cable works.

d) Daily and reserve fuel tank including the transfer pump.

2.6 **TESTING OF ATS**

a) Mechanical Operation Test Satisfactory
b) Functionality Test Satisfactory
c) Rated Current and Temperature Rise Test Satisfactory
d) Insulation Resistance Test Satisfactory
e) Power Frequency High Voltage Test

CHAPTER 3 CCTV SECURITY SYSTEM

3.1 GENERAL

Continuous monitoring system with several indoor and outdoor type cameras. Outdoor camera's will be installed at High Mast Light pole lantern carriage and other place as per drawing. Number of camera may be increased if feel necessary during the shop drawing.

3.2 IP IR BULLET-TYPE CAMERA (FIXED)

Supply and fixing of 4.0-megapixel IR fixed bullet IP outdoor camera, including 4.0/6.0 mm lens, bracket, housing Full HD 1080-pixel, real-time video, 3D DNR & DWDR & BLC, Smart IR LED up to 80 Meter, IP- 67, PoE Supported of the following technical specification as attached in the technical specification or equivalent. (Suitable to use corridor, entrance and outside peripheral)

a)	Image Sensor	: 1/2.7" or above 4 MP (Minimum) progressive CMOS
b)	Max. Resolution	: 2688 (H) × 1520 (V)
c)	Scanning System	: Progressive
d)	Electronic Shutter Speed	: Auto/Manual, 1 ~ 1/100000s
e)	Min. Illumination	: Color: minimum 0.002 lux @ (F1.2/F1.6, AGC ON),0 lux with IR
f)	IR Range	: Min. 70 meter or above
g)	Adjustment angle 355°	: Pan: 0° to 360°, tilt: 0° to 90°, rotate: 0° to
h)	Lens Type	: Fixed-focal
i)	Mount Type	: M12
j)	Focal Length	: 4/6 mm
k)	Max. Aperture	: F1.6
l)	Field of View 47°,	: 4 mm- Horizontal FOV: 85°, Vertical FOV:

Diagonal FOV: 90°,

6 mm - Horizontal FOV: 55°, Vertical FOV: 30°,

Diagonal FOV: 65°

m) Iris Type : Fixed

n) Smart Event

Support false alarm filtering: Cross Line detection, Intrusion detection, Enter Area detection, Leave Area detection, Motion detection, Ultra motion detection, tampering alarm, audio detection

o) Video Compression : Ultra 265, H.265, H.264

p) Video Frame Rate : Main Stream: 4MP (2688 × 1520), 25/30fps;
4MP (2560 × 1440), 25/30fps;

3MP (2304 × 1296), 25/30fps;

2 MP (1920 × 1080), 25/30fps.

Sub Stream: 720P (1280 × 720) 25/30fps;

D1 (720 × 576) 25/30fps.

Third Stream: D1 (720 × 576), 25/30fps;

2CIF (704 × 288) 25/30fps; CIF (352× 288), 25/30fps.

q) Stream Capability : Triple (3) streams (Minimum)

r) Resolution : 4 MP (2688 × 1520), 4 MP (2560 × 1440),
: 2 MP (1920 × 1080), 720P (1280 × 720)

s) Video Bit Rate : 128 Kbps~16 Mbps

t) Day/Night : Yes

u) BLC : Yes

v) HLC : Yes

w) WDR : 120 dB

x) White Balance : Yes

y) Noise Reduction : 3D NR

z) Region of Interest (ROI) : Yes (minimum 1 area)

aa) Smart Illumination : Yes

bb) Image Rotation : Yes

cc) Mirror : Yes

dd) Privacy Masking : Yes

ee) Alarm Event:

Motion detection, video tampering alarm, exception (Network disconnected, IP address conflict, illegal login,) intrusion detection, line crossing/ tripwire detection.

ff) Network : 1x RJ45 10M/100M self-adaptive Ethernet port

gg) Cyber Security

Password protection, strong password, HTTPS encryption, Export operation logs, basic and digest authentication for RTSP, digest authentication for HTTP, TLS 1.2, WSSE and digest authentication for ONVIF.

hh) Protocol

IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS, RTMP, SSL/TLS.

ii) Compatible Integration SDK : ONVIF (Profile S, Profile G, Profile T), API,

jj) User/Host : At least 30

kk) Storage : Micro SD card (support min 256 GB); NAS; FTP

ll) Browser :IE, Chrome, Firefox

mm) Certifications : UL, CE, FCC

nn) Audio Input :1 Channel (RCA port)

oo) Audio Output :1 Channel (RCA port)

pp) Operating Temperature and humidity : -30 °C to +60 °C (-22 °F to +140 °F), Humidity 95% or less (non-condensing)

qq) Power Supply :12 VDC ± 25%, PoE (802.3 at /af)

rr) Power Consumption : Max 12 watt

ss) Surge protection : 4 kV

tt) Ingression protection : IP67

uu) Casing : Metal

vv) Vandal resistant : IK10

ww) Certifications : CE, UL, FCC

3.3 **IP IR DOME TYPE CAMERA (FIXED)**

Supply and fixing of 4.0-megapixel IR fixed dome IP Camera, including 2.8 mm lens, bracket, housing full HD 1080-pixel, real time video, 3D DNR & DWDR & BLC, Smart IR LED up to minimum 40 Meters, IP-65, POE Supported of the following technical specification as attached in technical specification or equivalent. (Suitable to use lift, lobby, corridor).

a) Image Sensor : 1/1.8” or above 4 MP (Minimum) progressive CMOS

b) Max. Resolution : 2688 (H) × 1520 (V)

c) Scanning System : Progressive

d) Electronic Shutter Speed : Auto/Manual, 1 ~ 1/100000s

e) Min. Illumination : Color: minimum 0.002 lux @ (F1.2/F1.6, AGC ON),0 lux with IR

f) IR Range : Min. 40 meter or above

g) Adjustment angle : Pan: 0° to 360°, tilt: 0° to 90°, rotate: 0° to 355°

h) Lens Type : Fixed-focal

i) Mount Type : M12

j) Focal Length : 2.8 mm

k) Max. Aperture : F1.6

l) Field of View : Horizontal FOV: 95°, Vertical FOV: 50°, Diagonal FOV: 117°

m) Iris Type : Fixed

n) Smart Event

Support false alarm filtering: Cross Line detection, Intrusion detection, Enter Area detection, Leave Area detection, Motion detection, Ultra motion detection, tampering alarm, audio detection

o) Video Compression : Ultra 265, H.265, H.264

p) Video Frame Rate : Main Stream: 4MP (2688 × 1520), 25/30fps;
Sub Stream: 1080P (1920 × 1080), 25/30fps;
Third Stream: D1 (720 × 576), 25/30fps;

q) Stream Capability : Triple (3) streams (Minimum)

r) Resolution : 4 MP (2688 × 1520), 2 MP (1920 × 1080),

720P (1280 × 720)

s) Video Bit Rate : 128 Kbps~16 Mbps

t) Day/Night : Yes

u) BLC : Yes

v) HLC : Yes

w) WDR : 120 dB

x) White Balance : Yes

y) Noise Reduction : 3D NR

z) Region of Interest (ROI) : Yes (minimum 1 area)

aa) Smart Illumination : Yes

bb) Image Rotation : Yes

cc) Mirror : Yes

dd) Privacy Masking : Yes

ee) Alarm Event

Motion detection, video tampering alarm, exception (network disconnected, IP address conflict, illegal login,) intrusion detection, line crossing/tripwire detection.

ff) Network port : 1 x RJ45 10M/100M self-adaptive Ethernet

gg) Cyber Security

Password protection, strong password, HTTPS encryption, Export operation logs, basic and digest authentication for RTSP, digest authentication for HTTP, TLS 1.2, WSSE and digest authentication for ONVIF

hh) Protocol

IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS, RTMP, SSL/TLS

ii) Compatible Integration SDK : ONVIF (Profile S, Profile G, Profile T), API,

jj) User/Host : At least 30

kk) Storage FTP : Micro SD card (support min 256 GB); NAS;

ll) Browser : IE, Chrome, Firefox

mm) Audio Input : 1 Channel (RCA port)

nn)	Audio Output	: 1 Channel (RCA port)
oo)	Operating Temperature and humidity	: -30 °C to +60 °C (-22 °F to +140 °F), humidity 95% or less (non-condensing)
pp)	Power Supply	: 12 VDC ± 25%, PoE (802.3 at /af)
qq)	Power Consumption	: Max.09Watt
rr)	Surge protection	: 6 kV
ss)	Ingression protection	: IP67
tt)	Casing	: Metal
uu)	Vandal resistant	: IK10
vv)	Certifications	: CE, UL, FCC

3.4 **IP IR OUTDOOR PTZ SPEED DOME CAMERA**

Supply and fixing of 4.0 Megapixel IR OUTDOOR PTZ Speed Dome IP Camera including 6.0 ~ 225 mm Auto Focusing and zoom lens, mounting bracket boom of required length as per design and housing, Full HD real-time video with Face Detection, People Counting, support people flow counting and crowd density monitoring, suitable for different statistical scenarios,3D DNR & WDR & BLC, Smart IR up to Minimum 250 Meters or above distance, IP 67, PoE+ Supported of the following technical specification as attached in technical specification. (suitable to use wide outdoor area).

All camera will be mounted on High Mast light pole along with LED flood light. The camera will be hanged using a boom of dia 38mm from the lantern carriage and optical fiber cable associated with the camera will be run along the electrical cable using the winch pulley system of the high mast.

a)	Image Sensor	: 1/1.8” or above 4 MP (Minimum) progressive CMOS
b)	Max. Resolution	: 2688 (H) × 1520 (V)
c)	Scanning System	: Progressive
d)	Electronic Shutter Speed	: Auto, 1 ~ 1/100000s
e)	Min. Illumination	: Color: minimum 0.003 lux @ (F1.5 AGC ON), 0 lux with IR
f)	IR Range	: Min. 250 meter or above
g)	Adjustment angle	: Pan: 0° to 360°, tilt: 0° to 90°, rotate: 0° to 355°

h) Lens Type : Automatic Focusing and Motorized Zoom lens

i) Iris Type : Auto; F1.5 ~ F4.0

j) Focal Length : 6.0~225mm@F1.2, AF Max. Aperture: F1.6

k) Digital Zoom : 16 X

l) Optical Zoom : 40 X

m) Field of View : Horizontal FOV: 52.0° ~2.9°,
Vertical FOV: 31.0° ~1.8°,
Diagonal FOV: 64.0° ~3.01°,

n) Pan and Tilt : Pan Range: 360° (endless);
Pan Speed: 0.1°/s ~ 200°/s
Pan Preset speed: 300°/s
Tilt Range: –15° ~ 90° (auto reverse);
Tilt Speed: 0.1°/s ~ 200°/s;
Tilt Preset speed: 240°/s

o) Number of Presets : up to 1024

p) Preset Patrol : 16 patrols, up to 64 presets for each patrol

q) Route Patrol : 16 patrols, up to 32 actions for each patrol

r) Recorded Patrol : 16 patrols, up to 128 actions for each patrol

s) Patrol Stay Time : 15s~1800s

t) Serial Port : 1 × RS 485

u) Video Output : 1 × BNC

v) Smart Event

Support false alarm filtering: Cross Line detection, Intrusion detection, Enter Area detection, Leave Area detection, Motion detection, Ultra motion detection, tampering alarm, audio detection.

w) Video Compression : Ultra 265, H.265, H.264

x) Video Frame Rate : Main Stream: 4MP (2688 × 1520), 25/30fps;
Sub Stream: 1080P (1920 × 1080), 25/30fps;
Third Stream: D1 (720 × 576), 25/30fps;

y) Stream Capability : Triple (3) streams (Minimum)

z) Resolution : 4 MP (2688 × 1520), 2 MP (1920 × 1080),
720P (1280 × 720)

aa) Video Bit Rate : 128 Kbps~16 Mbps

bb) Day/Night : Yes

cc) BLC : Yes

dd) HLC : Yes

ee) WDR : 120 dB

ff) White Balance : Yes

gg) Noise Reduction : 3D NR

hh) Region of Interest (ROI) : Yes (minimum 1 area)

ii) Smart Illumination : Yes

jj) Image Rotation : Yes

kk) Mirror : Yes

ll) Privacy Masking : Yes

mm) Alarm Event

Motion detection, video tampering alarm, exception (Network disconnected, IP address conflict, illegal login,) intrusion detection, line crossing/ tripwire detection.

nn) Network : 1 RJ45 10M/100M self-adaptive Ethernet

oo) Cyber Security

Password protection, strong password, HTTPS encryption, Export operation logs, basic and digest authentication for RTSP, digest authentication for HTTP, TLS 1.2, WSSE and digest authentication for ONVIF.

pp) Protocol

IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS, RTMP, SSL/TLS.ICMP, ARP, TCP, UDP, DHCP, PPPoE,

qq) Compatible Integration SDK : ONVIF (Profile S, Profile G, Profile T), API,

rr) User/Host : At least 30

ss) Storage : Micro SD card (support min 256 GB); NAS; FTP

tt) Browser : IE, Chrome, Firefox

uu) Certifications : UL, CE, FCC

vv) Audio Input : 1 Channel (RCA port)

ww) Audio Output : 1 Channel (RCA port)

xx)	Operating Temperature	
yy)	and Humidity	: -40°C ~70°C (-40°F ~ 158°F) Humidity 95% or less (non-condensing)
zz)	Power Supply (IEEE802.3)	: AC 24V ±25%, DC 24V±25%, PoE++
aaa)	Power Consumption	: Max 60 Watt
bbb)	Surge protection	: 6 kV
ccc)	Ingression protection	: IP67
ddd)	Casing	: Metal
eee)	Vandal resistant	: IK10
fff)	Certifications	: CE, UL, FCC

3.5 **SURVEILLANCE HARD DISK DRIVE**

Supply and fixing of 16 TB Hot-swappable and RAID Supported Surveillance Hard Disk Drive for Storage Vehicle and Face Recognition data at Network Video Recorder (NVR) of the following specifications or equivalent Accepted/ Approved by the Engineer in Charge

a) Capacity : 16 TB
b) Form Factor : 3.5 Inch
c) Hot-Plug Swappable Support : Yes
d) Interface Access Speed (Gb/s) : SATA 6Gb/s
e) Recording Technology : CMR
f) Interface Ports : Single
g) Average Latency (ms) : 4.25
h) Spindle Speed (RPM) : 7200 RPM
i) Buffer : Min.256MB
j) Data Transfer Rates : Min. 260 MB/s or higher
k) Mean Time Between Failures (MTBF): Minimum 2, 500,000 hours or higher
l) Reliability Rating at Full 24×7 Operation (AFR): 0.35%
m) Rotation Vibration @ 20-1500 Hz (rad/sec²) : 14.5
n) Idle A (W) Average : 5.00W
o) Max Operating, Random Read/Write 4K/16Q (W):10.0 W
p) Power Supply Requirements: +12 V and +5 V
q) Temperature, Operating (°C) : - 5°C – 60°C

r) Warranty :05 years (to be attained from the supplier separately)

3.6 **VIDEO DECODER – 06 CHANNEL**

Supply and installation of Video decoder for video wall of the following specification or equivalent accepted by the Engineer in Charge.

a) Operating System : Linux OS
b) Form Factor : Rack Mount
c) Video input : 4 CH – HDMI video only
d) HDMI Input Resolution:

4K interface：3840 x 2160 (4K) @ 30Hz, 1920 x1080 (1080P) @ 60Hz,

1920 x 1080 (1080P) @ 50Hz, 1920 x 1080 (1080P) @ 30Hz;

1600 x 1200 (UXGA) @ 60Hz, 1440 x 900 (WXGA) @ 60Hz,

1280 x 1024 (SXGA) @ 60Hz; 1280 x 720 (720P) @ 60Hz,

1280 x 720 (720P) @ 50Hz, 1024 x 768 (XGA) @ 60Hz;

1080P interface：1920 x 1080 (1080P) @ 60Hz,

1920 x 1080 (1080P) @ 50Hz, 1920 x 1080 (1080P） @ 30Hz,

1600 x 1200 (UXGA) @ 60Hz, 1440 x 900 (WXGA) @ 60Hz,

1280 x 1024 (SXGA) @ 60Hz, 1280 x 720 (720P) @ 60Hz,

1280 x 720 (720P) @ 50Hz, 1024 x 768 (XGA) @ 60Hz

a) Video Output : 6 Ch – HDMI

b) HDMI Output Resolution:

4K interface：3840 x 2160(4K) @30Hz, 1920 x 1200 (WUXGA) @ 60Hz,

1920 x 1080 (1080P) @ 60Hz, 1600 x 1200 (UXGA) @ 60Hz,

1440 x 900 (WXGA+) @ 60 Hz, 1280 x 1024 (SXGA) @ 60Hz,

1280 x 720 (720P) @ 60Hz, 1024 x 768 (XGA) @ 60Hz

1080P interface：1920 x 1200(WUXGA)@60Hz,

1920 x 1080(1080P) @60Hz, 1600 x 1200(UXGA) @60Hz,

1440 x 900(WXGA+) @60Hz, 1280 x 1024(SXGA) @ 60Hz,

1280 x 720(720P) @60Hz, 1024 x 768(XGA) @60Hz

c) Decoding format : H.265, H.264, MPEG4

d) Decoding capability : 8 x 12MP @ 20Hz, 8 x 4K @ 30Hz, 32 x 1080P @ 30Hz,

72 x 720P@30Hz

e) Audio input : 1 x 3.5mm

f) Audio Output : 1 x 3.5mm, dual channel

g) Alarm input : 4

h) Alarm Output : 4

i) Network interface : 2 × GE Ethernet Interface

j) USB Interface : 2 x USB 3.0

k) Serial interface : 1 x RS-232 (RJ 45), 1x RS-485 (RJ45)

l) Power supply Unit : 100 - 240 VAC (with power on/off switch)

m) Power Consumption : Max. 32 W

n) Working temperature : -10°C ~ +55°C (+14°F ~ +131°F),10 to 90 % (RH)

o) Certifications : CE, UL, FCC

3.7 **VIDEO WALL MONITOR -55-INCH**

Supply and installation of55-inch Full HD Display for Video Wall monitor have high picture definition and color reproduction and can truly reproduce image information including 24-hourcontinuous and stable operation. The 178° viewing angle makes the picture still clear even when viewed from the side. Maximum 5ms response time for showing the effect on the screen perfectly and rapidly as per the following requirements or equivalent and features as directed by the Engineer in charge.

a) Panel size : 1m 38cm (55" inch)

b) Pixel pitch (mm) : 0.315 x 0.315

c) Resolution : 1920 x 1080

d) Color : 16.7 M

e) Light source : LED backlight

f) Brightness (cd/m2) : 500

g) Contrast Ratio : 4000:1
h) Response time (ms) : 8
i) Viewing angle (H/V) : Horizontal 178°, Vertical 178°
j) Video input interface : 2 x HDMI, 1 x VGA, 1 x DVI,
k) Video Loop Out : 1 x HDMI
l) USB Interface : 1 x USB
m) Control Interface : 1 x RS-232 IN, 1 x RS-232 OUT, 1 x IR
n) Picture Engine equivalent : Crystal Processor 4K / Hyper Real or
o) Active Noise Reduction : Yes
p) Aspect ratio : 16:9
q) HDMI Cable including : Min. 2 x 10 Meter Optical HDMI Cable
r) Power Supply : Input voltage AC 100～240V, 50/60Hz
s) Power Consumption (Max): 200 W
t) Operation temperature : 0℃～40℃
u) Operation humidity : 20%～85% (non-condensing)
v) Dimensions (W×H×D) : 1213.50mm x 684.30mm x 125.19mm
w) Certification and Compliance : FCC, CE, ETL, UL, RoHS

3.8 **NETWORK KEYBOARD**

Supply and fixing of Network Keyboard for PTZ cameras of following technical specifications or equivalent.

a) Screen size : Minimum 10.2 inches LED
b) Decoding format : H.265/H.264
c) Decoding capability : 1× 4K@25fps/4× 1080@30fps/8× 720P@30fps
d) Split screen : 1/4/9 Channel
e) Signal output : HDMI output 1920× 1080@60Hz resolution
f) Serial port : 1 × RS232 (DB9, reserved)1 × RS485 (half-duplex, reserved)
g) HDMI output : 1 × HDMI output
h) USB : 1 × USB
i) Network : 1 × 10M/100M Ethernet interface (RJ45)
j) Audio : 1 ×Standard 3.5mm audio jack (reserved)
k) Power : DC 12V power interface

l) Power consumption : < 15W
m) Operating temperature : -10℃ to 40℃
n) Operating humidity : 10% to 90% RH (non-condensing)
o) Certifications : CE, UL, FCC

3.9 **OPTICAL FIBER HDMI CABLE - 10 METER**

Supply and fixing of HDMI Male to Male Optical Fiber Cable for Connecting CCTV Display of the following technical specifications or equivalent.

a) Type : Optic Fiber HDMI Male to Male flexible cable
b) Feature : Lossless signal transmission, Quad-core optical fiber
c) Length : Minimum 10 Meter
d) Interface(s) : HDMI Male
e) Resolution : Max. 3840 x 2160
f) Color : Black
g) Compatibility OS : Linux/Windows

3.10 **OPTIC FIBER HDMI CABLE - 05 METER**

Supply and fixing of HDMI Male to Male Optical Fiber Cable for Loop Connecting of CCTV Display of the following technical specifications or equivalent.

a) Type : Optic Fiber HDMI Male to Male flexible cable
b) Feature : Lossless signal transmission, Quad-core optical fiber
c) Length : Maximum 05 Meter
d) Interface(s) : HDMI Male
e) Resolution : Max. 3840 x 2160
f) Color : Black
g) Compatibility OS : Linux/Windows

3.11 **DESKTOP PC WITH MONITOR 24 INCH**

Supply, installation, testing and commissioning of Desktop PC for Operation and Configuration of Digital Surveillance System with 24 Inch FHD Monitor Core i7 12th Gen, DDR4 16GB, 3200MHZ, 512 SSD, 02 TB SATA HDD, 2 GB Graphics card with following specifications and features or equivalent as per direction of the Engineer in charge.

a) Chassis Type : Micro Tower
b) Processor : 12thGen IntelCorei7-12700 12-Core CPU
c) Speed : Min. Turbo Frequency - 4.80 GHz,

d)	Cache Memory	: 25 MB Cache
e)	RAM	: 16 GB (16 ×1) DDR4 3200MHz
f)	Memory Slots	: Min. 4 DIMM Slots
g)	Mother Board	: Intel B660 Express Chipset or Higher
h)	I/O Interface	: 2 x USB 2.0, 2 x USB 3.2 Gen 1 Type (Front), 2 xUSB 2.0, 2 x USB 3.2 Gen 1 Type (Rear); 1 RJ-45; 1 VGA; 1 HDMI; 2 Display ports; Front panel Mic-in, Headphone out, Back panel Mic-in/Line-in, Line-out
i)	Storage HDD	: 512GB M.2 PCIe NVMe SSD+ 02 TB SATA
j)	Optical Drive	: Portable DVD RW
k)	Graphics	: Intel UHD 02 GB Graphics or higher
l)	NIC	: 1 x RJ-45 port 10/100/1000 Mbps
m)	Monitor	: 24” FHD Monitor of the same brand
n)	Mouse	: USB Optical Mouse of the same brand
o)	Keyboard	: USB Keyboard of the same brand
p)	Operating System	: Free DOS
q)	Power Supply	: 240W EPA Internal PSU

3.12 **ON LINE UPS – 10 KVA**

Supply of 10kVA uninterruptible power supply (UPS) complete with central processing unit suitable for input power supply 304–498 VAC Three Phase 50 Hz and output voltage 220 V AC ± 5%, 50 Hz single phase Back-up time: 2 HOURS at full load and 4 HOURS at half load including protection for lightening and surge, back-out, over and under voltage, overload, battery low and over-charge etc. complete as required as per sample approved by the Engineer.

3.12.1 **Input Parameters**

a)	Rectifier Type	: IGBT Rectifier
b)	Rated Voltage Wire	: 380/400/415 Vac Three Phase Four
c)	Input Voltage Range	: Three Phase 304Vac-498Vac
d)	Input Frequency Range	: 40 Hz-70Hz
e)	Input Power Factor	: >=0.99 for Single Phase
f)	THDi	: <5%

3.12.2 **Battery**

a) Battery Type : Lead Acid Maintenance Free
b) Charging Capability : 13A
c) Battery Capacity : 12V- 120 Ah
d) Backup time : 2 hours Full load
e) Battery Rack : Tower (External)
f) No of Battery : 16 pcs
g) Mounting Kit : Rack type Battery bank

3.12.3 **Output Parameters**

a) Rated Power : 10KW
b) Rated Voltage : Three Phase 380/400/415 Vac or Single Phase 230/220 Vac.
c) Output PF : .95
d) Voltage Stability : 1%
e) Output Frequency : 50 Hz/ 60 Hz
f) Frequency Precision : 0.25%
g) Output Voltage THD : <2% for Linear Load and <5% for Non -Linear
h) Load Crest Factor : 3:1 Comply with IEC 62040-3
i) Step Load : 1
j) Output Mode : Terminal Strip
k) Programmable outlets : Yes
l) Overload Performance : (% of 105%-125% 5 Mins, 125%-150% 1Min, 500ms for >150%

3.12.4 **System parameters and Standards**

a) Conversion Type : Online Double Conversion
b) Parallel Mode : 3+1
c) Installation Mode : Rack/Tower Convertible
d) System Efficiency : 0.96
e) Switching Time : 0 m sec
f) Noise : >55dB
g) LCD Display : Yes
h) Safety : I EC/EN62040-1-1
i) Electromagnetic Compatibility : IEC/EN62040-2, IEC/EN61000-3-11, IEC/EN61000-3-12, YD/Tl095-2008

j) Surge Protection :IEC/EN62040-2,
Meeting IEC/EN61000-4-5

k) Energy star certificate : Yes

l) Protection Level : IP20

m) Parallel Mode : Up to 4 units

3.12.5 **Communication and Management**

a) Interface Type : USB/Intelligent Slot (Dry Contact Card/SIC Card/Modbus Card/RS485 Card

b) SNMP card : Integrated with UPS

c) Management : Site Monitor

3.12.6 **Environmental Parameters**

a) Operating Temp : 0°C – 50 °C

b) Relative Humidity : 0 - 95% without Condensation

c) Max Altitude : <3000 meters

d) Certification : IEC/EN 62040-1, IEC/EN 62040-2, VFI-SS-111, CE,Energy star, seismic, shipment, Dust and Moistureproof, high altitude.

3.13 CORE SWITCH - 28 PORT

Supply, installation, testing and commissioning of Core Switch – 28 Port (24 × 10/100/1000 Ethernet and4 × 1GE/10GE SFP uplink SFP+ ports are compatible with 1 GE SFP) with the following specification and features or equivalent as per direction of the Engineer in charge.

a) Total Network Interfaces : 24 × 10/100/1000 Ethernet ports and
4 × 1GE/10GE SFP Uplinks ports.

SFP+ ports are compatible with 1 GE SFP.

b) Dedicated Management Port : 1

c) RJ-45 Serial Console Port : 1

d) Form Factor : 1 RU Rack Mount

e) Ethernet Ports : 24 × 10/100/1000 Ethernet

f) LEDs : System, Link/Act, PoE, Speed

g) Mean Time Between Failures: > 10 years

h) Forwarding Capacity (Duplex): Min. 128 Gbps or Higher

i) Switching Capacity (Duplex): Min. 128 Gbps or Higher

j) Packets Per Second (Duplex): Min. 200 Mpps or Higher

k) MAC Address Storage : Min. 4 K or Higher

l) Network Latency : < 1μs

m) Packet Buffers : Min. 2048 KB or higher

n) DRAM : Min. 01 GB DDR4or Higher

o) FLASH : Min. 256 MD or Higher

p) USB Slot : USB Type-A slot on the front/back panel of the switch for easy file and image management

q) ACL :Support for up to 1,024 rules

Drop or rate limit based on source and destination MAC, VLAN ID, IPv4 or IPv6 address, IPv6 flow label, protocol, port, Differentiated Services Code Point (DSCP)/ IP precedence, Transmission Control Protocol/ User Datagram Protocol (TCP/UDP) source and destination ports, 802.1p priority, Ethernet type, Internet Control Message Protocol (ICMP) packets, IGMP packets, TCP flag; ACL can be applied on both ingress and egress sides. Time-based ACLs supported

r) DoS prevention : Denial-of-Service (DOS) attack prevention.

s) Secure Shell (SSH) Protocol: SSH is a secure replacement for Telnet traffic. Secure Copy Protocol (SCP) also uses SSH.

SSH v1 and v2 are supported

t) Secure Sockets Layer (SSL): SSL support: Encrypts all HTTPS traffic, allowing highly secure access to the browser-based management GUI in the switch

u) Web-based authentication : Web-based authentication provides network admission control through web browser to any host devices and operating systems

v) Port security : Ability to lock source MAC addresses to ports Andlimits the number of learned MAC addresses.

w) Spanning Tree Instances : Standard 802.1d Spanning Tree support

i. Fast convergence using 802.1w (Rapid

ii. Spanning Tree [RSTP]), enabled by default

iii. Multiple Spanning Tree instances using 802.1s(MSTP); 8 instances are supported Per-VLAN

iv. Spanning Tree Plus (PVST+) and Rapid

v. PVST+; 126 instances are supported

x) Link Aggregation Group Size : Up to 8 groups

y) Total Link Aggregation Groups : Up to 8 groups

z) VLAN simultaneously : Support for up to 4K VLANs

i. Port-based and 802.1Q tag-based VLANs;

ii. MAC-based VLAN; protocol-based VLAN;

iii. IP subnet-based VLAN; Management VLAN

iv. Dynamic VLAN assignment via RADIUS

v. server along with 802.1x client authentication.

aa) IPv4 routing : Wire speed routing of IPv4 packets
Up to 990 static routes and up to 128 IP

bb) IPv6 routing : Wire speed routing of IPv6 packets

cc) Layer 2/3 Interface physical : Configuration of Layer 2/3 interface on port, Link Aggregation (LAG), VLAN interface, or loopback interface

dd) Power Required : 100–240V AC, 50/60 Hz

ee) Power Supply : AC Built in

ff) Redundant Power : Redundant AC

gg) Power Consumption : Max. 23.6 W 220 V AC

hh) Heat Dissipation : Min. 76.4 BTU/h or Less

ii) Operating Temperature : 32°-113°F (0°–45°C)

jj) Storage Temperature : -40°–158°F (-40°–70°C)

kk) Humidity : 10%–90% non-condensing

ll) Air-Flow Direction : side-to-back

mm) Noise Level : 32.3 dBA

nn) Buttons : Reset button

oo) Certification and Compliance : FCC, CE, RCM, BSMI, UL, CB, RoHS2

3.14 **FIBER DISTRIBUTION SWITCH - 28 PORT**

Supply, installation, testing and commissioning of Optical Fiber Distribution Switch – 28 SFP Port (24 × 1G SFP and 4 × 1G/10G SFP uplink SFP+ ports are compatible with 1 GE SFP) with the following specifications and features or equivalent as per direction of the Engineer in charge.

a. Total Network Interfaces : 24 × 1 GE SFP Case slot ports and 4 × 1G/10G SFP+ Case slots uplinks ports. SFP+ ports are compatible with 1 GE SFP.
b. Dedicated Management Port : 1
c. RJ-45 Serial Console Port : 1
d. Form Factor : 1 RU Rack Mount
e. SFP Case slot Ports : 24SFP
f. LEDs : System, Link/Act, PoE, Speed
g. Mean Time Between Failures : > 10 years
h. Forwarding Capacity (Duplex): Min. 56 Gbps or Higher
i. Switching Capacity (Duplex) : Min. 128 Gbps or Higher
j. Packets Per Second (Duplex) : Min. 200 Mbps or Higher
k. MAC Address Storage : Min. 30 K or Higher
l. Network Latency : < 1µs
m. Packet Buffers : Min. 4 MB or higher
n. DRAM : Min. 01 GB DDR4or Higher
o. FLASH : Min. 256 MB or Higher
p. USB Slot : USB Type-A slot on the front/back panel of the switch for easy file and image management
q. ACL : Support for up to 1.5 K rules

Drop or rate limit based on source and Destination MAC, VLAN ID, IPv4 or IPv address, IPv6 flow label, protocol, port, Differentiated Services Code Point (DSCP)/IP precedence, Transmission Control Protocol/ User Datagram Protocol (TCP/UDP) source and destination ports, 802.1p priority,

Ethernet type, Internet Control Message Protocol (ICMP) packets, IGMP packets, TCP flag; ACL can be applied on both ingress and egress sides. Time-based ACLs supported

r. DoS prevention : Denial-of-Service (DOS) attack prevention.

s. Secure Shell (SSH) Protocol : SSH is a secure replacement for Telnet traffic. Secure Copy Protocol (SCP) also uses SSH.

SSH v1 and v2 are supported

t. Secure Sockets Layer (SSL) : SSL support: Encrypts all HTTPS traffic, Allowinghighly secure access to the browser-based management GUI in the switch

u. Web-based authentication : Web-based authentication provides network admission control through web browser to any host devices and operating systems

v. Port security : Ability to lock source MAC addresses to ports andlimits the number of learned MAC addresses.

w. Spanning Tree Instances : Standard 802.1d Spanning Tree support

i. Fast convergence using 802.1w (Rapid Spanning Tree [RSTP]), enabled by default

ii. Multiple Spanning Tree instances using 802.1s(MSTP);

iii. 8 instances are supported Per-VLAN Spanning Tree Plus (PVST+) and RapidPVST+;

iv. 126 instances are supported

x. Link Aggregation Group Size: Up to 8 groups

y. Total Link Aggregation Groups: Up to 8 groups

z. VLAN : Support for up to 4K VLANs simultaneously

i. Port-based and 802.1Q tag-based VLANs;

ii. MAC-based VLAN; protocol-based VLAN;

iii. IP subnet-based VLAN; Management VLAN

iv. Dynamic VLAN assignment via RADIUS

v. Server along with 802.1x client authentication.

aa.	IPv4 routing	: Wire speed routing of IPv4 packets Up to 990 Staticroutes and up to 128 IP
bb.	IPv6 routing	: Wire speed routing of IPv6 packets
cc.	Layer 3 Interface	: Configuration of Layer 3 interface on physical port, Link Aggregation (LAG), VLAN interface, or loop back interface
dd.	Power Required	: 100–240V AC, 50/60 Hz
ee.	Power Supply	: AC Built in
ff.	Redundant Power	: Redundant AC
gg.	Power Consumption	: Max. 38.0W 220 V AC
hh.	Heat Dissipation	: Min. 132.5 BTU/h or Less
ii.	Operating Temperature	: 32°-113°F (0°–45°C)
jj.	Storage Temperature	: -40°–158°F (-40°–70°C)
kk.	Humidity	: 10%–90% non-condensing
ll.	Air-Flow Direction	: side-to-back
mm.	Noise Level	: 32.8 dBA
nn.	Buttons	: Reset button
oo.	Certification and Compliance	: FCC, CE, RCM, BSMI, UL, CB, RoHS2

3.15 **ACCESS POE SWITCH - 24 PORT**

Supply, installation, testing and commissioning of Access PoE Switch – 28 Port (24 × 10/100/1000 Ethernet PoE+ ports and 4 × 1G SFP Case Slots) with the following specification and features or equivalent as per direction of the Engineer in charge.

a)	Total Network Interfaces	: 24 × 10/100/1000 Ethernet PoE+ ports 4 × 1G SFP Uplinks ports
b)	RJ-45 Serial Console Port	: 1
c)	Form Factor	: 1 RU Rack Mount
d)	Power over Ethernet (PoE+) Ports	: 24 (802.3af/at)
e)	Time-based PoE	: PoE+ power can be on or off based on user-defined schedule to save energy
f)	PoE Power Budget	: Min. 370 W or Higher
g)	LEDs	: System, Link/Act, PoE, Speed
h)	Mean Time Between Failures	: > 10 years
i)	Forwarding Capacity (Duplex)	: Min. 28 Gbps or Higher

j) Switching Capacity (Duplex) : Min. 56 Gbps or Higher

k) Packets Per Second (Duplex) : Min. 41 Mpps or Higher

l) MAC Address Storage : Min. 16 K or Higher

m) Network Latency : Min. 4µs or Less

n) Packet Buffers : Min. 1536 KB or higher

o) CPU : Min. 900 MHz ARM or Higher

p) DRAM : Min. 512 MB DDR3or Higher

q) FLASH : Min. 256 MB or Higher

r) USB Slot : USB Type-A slot on the front/back panel of the switch for easy file and image management

s) ACL : Support for up to 1,024 rules

i. Drop or rate limit based on source and

ii. Destination MAC, VLAN ID, IPv4 or IPv6 address, IPv6 flow label, protocol, port,

iii. Differentiated Services Code Point (DSCP)/IP precedence, Transmission Control Protocol/User Datagram Protocol (TCP/UDP) source anddestination ports, 802.1p priority, Ethernet type,

iv. Internet Control Message Protocol (ICMP) packets, IGMP packets, TCP flag; ACL can beapplied on both ingress and egress sides.

v. Time-based ACLs supported

t) DoS prevention : Denial-of-Service (DOS) attack prevention.

u) Secure Shell (SSH) Protocol traffic. : SSH is a secure replacement for Telnet

i. Secure Copy Protocol (SCP) also uses SSH.

ii. SSH v1 and v2 are supported

v) Secure Sockets Layer (SSL): SSL support: Encrypts all HTTPS traffic, allowing highly secure access to the browser-based management GUI in the switch

w) Web-based authentication : Web-based authentication provides network

admission control through web browser to any host devices and operating systems

x) Port security : Ability to lock source MAC addresses to ports and limits the number of learned MAC addresses.

y) Spanning Tree Instances : Standard 802.1d Spanning Tree support

a. Fast convergence using 802.1w (Rapid Spanning Tree [RSTP]), enabled by default

b. Multiple Spanning Tree instances using 802.1s(MSTP);

c. 8 instances are supported Per-VLANSpanning Tree Plus (PVST+) and RapidPVST+; 126 instances are supported

z) Link Aggregation Group Size : Up to 8 groups

aa) Total Link Aggregation Groups : Up to 8 groups

bb) VLAN : Support for up to 4,094 VLANs simultaneously

i. Port-based and 802.1Q tag-based VLANs;

ii. MAC-based VLAN; protocol-based VLAN;

iii. IP subnet-based VLAN; Management VLAN

iv. Dynamic VLAN assignment via RADIUSserver along with 802.1x client authentication.

cc) IPv4 routing : Wire speed routing of IPv4 packets Up to 990 staticroutes and up to 128 IP interfaces

dd) IPv6 routing : Wire speed routing of IPv6 packets

ee) Layer 3 Interface : Configuration of Layer 3 interface on physical Port, Link Aggregation (LAG), VLANinterface, or loop back interface

ff) Power Required : 100–240V AC, 50/60 Hz

gg) Power Supply : AC Built in

hh) Power Consumption : Max. 236.0W 220 V AC

ii) Heat Dissipation : Min. 820.7 BTU/h or Less

jj) Operating Temperature : 32°-113°F (0°–45°C)

kk) Storage Temperature : -40°–158°F (-40°–70°C)

ll) Humidity : 10%–90% non-condensing
mm) Air-Flow Direction : side-to-back
nn) Noise Level : 42.5 dBA
oo) Buttons : Reset button
pp) Certification and Compliance: FCC, CE, RCM, BSMI, UL, CB, RoHS2

3.16 **ACCESS POE SWITCH – 08 PORT**

Supply, installation, testing and commissioning of Access PoE Switch – 10 Port (8 × 10/100/1000 Ethernet PoE+ ports and 2 × 1G SFP Case Slots (Uplinks ports) with the following specification and features or equivalent as per direction of the Engineer in charge.

a) Total Network Interfaces : 8 × 10/100/1000 Ethernet PoE+ ports
2 × 1G SFP Uplink ports
b) RJ-45 Serial Console Port : 1
c) Form Factor : 1 RU Rack Mount
d) Power over Ethernet (PoE+) Ports : 08 (802.3af/at)
e) Time-based PoE : PoE+ power can be on or off based on the user-define schedule to save energy
f) PoE Power Budget : Min. 130 W or Higher
g) LEDs : System, Link/Act, PoE, Speed
h) Mean Time Between Failures : > 10 years
i) Forwarding Capacity (Duplex) : Min. 18 Gbps or Higher
j) Switching Capacity (Duplex) : Min. 20 Gbps or Higher
k) Packets Per Second (Duplex) : Min. 30 Mpps or Higher
l) MAC Address Storage : Min. 8 K or Higher
m) Network Latency : Min. 4µs or Less
n) Packet Buffers : Min. 512 KB or higher
o) CPU : Min. 900 MHz ARM or Higher
p) DRAM : Min. 256 MB DDR3or Higher
q) FLASH : Min. 256 MB or Higher
r) USB Slot : USB Type-A slot on the front/back panel of the switch for easy file and image management
s) ACL :

Support for up to 640 rules

i. Drop or rate limit based on source and Destination MAC, VLAN ID, IPv4 or IPv6 address, IPv6 flow label, protocol, port,

ii. Differentiated Services Code Point (DSCP)/ IP precedence, Transmission Control Protocol/ User Datagram Protocol (TCP/UDP) source and destination ports, 802.1p priority, Ethernet type,

iii. Internet Control Message Protocol (ICMP), packets, IGMP packets, TCP flag; ACL can be applied on both ingress and egress sides.

iv. Time-based ACLs supported

t) DoS prevention : Denial-of-Service (DOS) attack prevention.

u) Secure Shell (SSH) Protocol: SSH is a secure replacement for Telnet traffic.

a. Secure Copy Protocol (SCP) also uses SSH.

b. SSH v1 and v2 are supported

v) Secure Sockets Layer (SSL):

SSL support: Encrypts all HTTPS traffic, highly secure access to the browser-based management GUI in the switch

w) Web-based authentication : Web-based authentication provides network admission control through web browser to any host devices and operating systems

x) Port security : Ability to lock source MAC addresses to Portslimits the number of learned MAC addresses.

y) Spanning Tree Instances : Standard 802.1d Spanning Tree support

i. Fast convergence using 802.1w (Rapid Spanning Tree [RSTP]), enabled by default

ii. Multiple Spanning Tree instances using 802.1s(MSTP); 8 instances are supported

iii. Per-VLAN Spanning Tree Plus (PVST+) and Rapid PVST+; 126 instances are supported

z) Link Aggregation Group Size : Up to 8 groups

aa) Total Link Aggregation Groups : Up to 8 groups

bb) VLAN : Support for up to 4,094 VLANs simultaneously

a. Port-based and 802.1Q tag-based VLANs;

b. MAC-based VLAN; protocol-based VLAN;

c. IP subnet-based VLAN; Management VLAN

d. Dynamic VLAN assignment via RADIUS

e. Server along with 802.1x client authentication.

cc) IPv4 routing : Wire speed routing of IPv4 packets
Up to 990 static routes and up to 128 IP

dd) IPv6 routing : Wire speed routing of IPv6 packets

ee) Layer 2/3 Interface : Configuration of Layer 2/3 interface

ff) Power Required : 100–240V AC, 50/60 Hz

gg) Power Supply : AC Built in

hh) Power Consumption : Min. 135.19 W / 136.10 W

ii) Heat Dissipation : Min. 17.7 BTU/h or Less

jj) Operating Temperature : 32°-113°F (0°–45°C)

kk) Storage Temperature : -40°–158°F (-40°–70°C)

ll) Humidity : 10%–90% non-condensing

mm) Air-Flow Direction : side-to-back

nn) Noise Level : Fan less

oo) Buttons : Reset button

pp) Dimensions (H x D x W) : 44 x 209 x 330

qq) Certification and Compliance: FCC, CE, RCM, BSMI, UL, CB, RoHS2

3.17 **SFP MODULE 1.25G**

Supply, installation, testing and commissioning of 1.25G SFP Modules Single Mode Fiber LC types the following specifications or equivalent and features as per direction of the Engineer in charge

a) Quality : ISO 9001/9002 for manufacturer, FCC Class A/B for quality assurance

b) Power Supply : The Host Power Supply and Hot swappable

c) Voltage Range : DC 3.15V～3.45V

d) Power Consumption : Max. 01W

e) Optical Wave Length : 1550nm TX / 1310nm RX

f) Emission Light Power : -8～0 dBm

g) Receiver Sensitivity : -22 dBm

h) Optical Fiber Type : Single mode 9/125um

i) Optical Fiber Port : 1x LC Type
j) Transmission Distance : Single Mode Fiber Min. 20 kilometers
k) Material : Stainless Steel
l) Electrostatic Discharges (ESD) Protection:
m) Working Temperature : -40℃~85℃
n) Humidity (non-condensing): 0~95%
o) Safety : Laser Class I 21CFR1040 LN#50 7/2001
Laser Class I IEC 60825-1
p) Standards : IEEE 802.3z, IEEE 802.3ah GR-326-CORE

3.18 **SERVER CABINET RACK–42U**

Supply and fixing of 42U Server Cabinet network rack Full Vented Top Frame with Front / Rear / Side Cable Entrance4 × 4-inch Top Fan Tray with Guard and Filter (Low Noise) specifically designed for digital surveillance storage server applications of following technical specification or equivalent.

a) Cabinet Size : W 800 mm x D 1000 mm x H 2055 mm
b) Raw Material : SPCC Cold Rolled Steel
c) Thickness : Mounting Profile 2.0mm, 19-inch Panel Mounting1.5mm, Others 1.2mm
d) Cooling Fan : 4 ×4-inch FAN with UK Power Cord on Top
e) Cabinet Structure:
Full Vented Top Frame with Front / Rear / Side Cable Entrance with Assemble frame structure. Easily removable Front/ Rear/ Side doors, allowing access at all lateral sides. Hassle-free side-by-side racks-baying feature
f) Front Door Option : Tempered glass door with round/striped hole and Advanced Swivel Lock
g) Rear Door Option : High-density single open vented Sheet steel door with Advanced Swivel Lock
h) Ventilation Percentage : >75% High density vented door
i) Side Panel lock : Half height, removable side panel with cam
j) Rail Kit : 19” Powder Coated, 2.0mm thick SPCC
k) Power Distribution Unit type : 2× 12 Way Vertical ZeroU PDU with 13A UK

l) Finish : Powder coated

m) Max. Open Angel : 180 degrees

n) Color : Fully powder coated (RAL9004 Black)

o) Static Load Capacity (KG) : Min. 1000 kg or above

p) Ingress Protection : Up to IP20 protection or above

q) Certifications : Comply with CE, UL, FCC ANSI/EIA RS-310-D,IEC297-2, DIN 41491; PART 1 DIN 41494; PART 7, GB/T 3047.2-92, ETSI Standard, RoHS.

3.19 **NETWORK CABINET RACK – 6U**

Supply and fixing of 6U Network Cabinet rack Full Vented Top Frame with Front / Rear / Side Cable Entrance 2× 4-inch Top Fan Tray with Guard and Filter (Low Noise) specifically designed for digital surveillance applications of following technical specification or equivalent.

a) Cabinet Size : W 600 mm× D 450 mm× H 368 mm

b) Raw Material : SPCC Cold Rolled Steel

c) Thickness : Mounting Profile 2.0mm, 19-inch Panel Mounting 1.5mm,

Others 1.2mm

d) Cooling Fan : 2× 4-inch FAN with UK Power Cord on Top

e) Cabinet Structure : Full Vented Top Frame with Front / Rear Cable Entrance with Assemble frame structure. Easily removable side panels with lock.

f) Front Door Option : Tempered glass door with round/ striped hole and Advanced Swivel Lock

g) Ventilation Percentage : >75% High density vented door

h) Side Panel : Removable side panel with cam lock

i) Power Distribution Unit : 1 ×6 Way Vertical ZeroU PDU with 13A UK type

j) Finish : Powder coated

k) Max. Open Angel : Wide Front Door swing angle over 180 degrees

l) Color : Fully powder coated (RAL9004 Black)

m) Static Load Capacity (KG) : Min. 60 kg or above

n) Ingress Protection : Up to IP20 protection or above

o) Certifications : Comply with CE, UL, FCC ANSI/EIA RS-

310-D,IEC297-2, DIN 41491; PART 1 DIN 41494; PART 7, GB/T 3047.2-92, ETSI Standard, RoHS.

3.20 **OUTDOOR NETWORK CABINET RACK – 4U**

Supply and fixing of 4U lockable Pole Mounted Outdoor network racks are designed to protect sensitive network equipment from harsh environments where equipment may be exposed to dust or water. Made from powder-coated and welded cold rolled steel with IP65 rating for extra protection from the elements specifically designed for digital surveillance applications of following technical specification or equivalent.

a) Cabinet Size : W 600 mm× D 450 mm× H 266 mm
b) Raw Material : Powder-coated and welded Cold Rolled Steel
c) Thickness : Mounting Profile 2.0mm, 19-inch Panel Mounting 1.5mm, Others 1.2mm
d) Cooling Fan : 2× 4-inch FAN with UK Power Cord on Top
e) Cabinet Structure :
    i. Supplied fully assembled Lockable front door, Rain hood included,
    ii. Sealed bottom cable entry gland, Water and dust proof polyurethane door joint strip,
    iii. Adjustable 19” mounting rails front and rear, Grounding pin with Front door rubber seal.
f) Front Door Option : Powder-coated and cold rolled steel door with lock
g) Power Distribution Unit type : 1 ×6 Way Vertical ZeroU PDU with 13A UK
h) Finish : Powder coated
i) Max. Open Angel : 130 degrees
j) Color : Fully powder coated (GREY RAL7035)
k) Static Load Capacity (KG) : Min. 50 kg or above
l) Ingress Protection : Min. IP65 protection or above
m) Certifications : Comply with CE, UL, FCCEN60529/10.91, RoHS2,DIN41491, DIN41494, EIA/ECA-310-E, IEC 294-2

3.21 **SINGLE MODE OPTICAL FIBER – 12CORES**

Supply, installation, testing and commissioning of 24 core Single-mode Optical Fiber Cable (outdoor) with the following specification or equivalent as per direction of the Engineer in charge.

3.21.1 **Specification:**

Armored single loose tube fiber optic cable (50 / 125 µm multi-mode, 12-Core) suitable for internal and external applications in ducts and having outer diameter of app. 6.5 mm and weight app. 35.0 kg/km etc. Complete with all required accessories. General 12-Core single mode (OS2), Single Jacket, Corrugated steel tape armor, Gel-free, Stranded Loose tube Fiber cable. Qualification Standards ANSI/ICEA S-87-640, EN 187105, Telcordia GR-20. Compliance ITU-T G.652.D, ITU-T G.657.A1 (bend insensitive) and TIA- 492CAAB (OS2)

3.21.2 **Construction Materials:**

a) Jacket Material : PE / MDPE
b) Environmental space : Aerial, lashed and buried applications.
c) Strength member, central : Di-electric Rod
d) Strength member, peripheral: Water swellable tape
e) Number of fibers per tube : 6core/ 12 core
f) Jacket UV Resistance : UV Stabilized
g) Subunit Type : 2.5mm Gel-free buffer tubes
h) No. of Rip cords : 2"

3.21.3 **Mechanical Specifications:**

a) Cable Diameter : customized as per number of cores
b) Cable Weight : 100 – 120 kg/km
c) Minimum Bend Radius, loaded : 17.5 cm
d) Minimum Bend Radius, unloaded : 11.7 cm
e) Tensile Load, long term, Max : 800 N or better
f) Tensile Load, short term, Max : 2700 N or better
g) Vertical Rise : up to 700 meters
h) Operating Temperature : -40 degree Celsius to +70 degree Celsius

3.21.4 **Mechanical Test Specifications:**

a) Compression : 44 N/mm (as per IEC 60794-1 E3)
b) Flex : 35 Cycles (as per IEC 60794-1 E6)
c) Impact : 4.41 N-m (as per IEC 60794-1 E4)
d) Water Penetration Test Method: 24 h (IEC 60794-1 F5)"

3.21.5 **Optical Specifications:**

Attenuation, Maximum : 0.22 dB/km @ 1550 nm

0.25 dB/km @ 1490 nm

0.31 dB/km @ 1385 nm

0.34 dB/km @ 1310 nm

Factory Test Report Shall be available publicly against unique tracking ID on cable, at OEM website.

3.22 **OPTICAL FIBER DISTRIBUTION (ODF) PANEL – 24 PORTS**

Supply, installation, testing and commissioning24 port Fiber Rack Mount Patch Panel with LC adapter and LC SM 1.5-meter Pigtail with the following specification as per direction of the Engineer in charge.

a) Mounting place : Inside winch control building & open repair Facility.

b) Frame Factor : Rack Mount type

c) Adapter and Pigtail : LC/ type

d) General :

i. Low profile, takes up only one unit of rack Space. 1U = 45 mm (1.75 in.)

ii. Patch panel can be ordered in Gary or Black Universal Connector Panel and Strips allowing flexible and customized patch panel design.

iii. Mounted on a hinge, swings out to allow easy access to the back of the panel, from the front.

iv. Rugged design protects fiber terminations and fiber connectors

v. Compatible with 203 mm (8 in.) Splice Organizer Tray, allows for splicing optical pigtails

vi. Connector capacity: 12 X 4 (Four strips) (up to 48 fibers with LC connectors)

vii. Splice Tray capacity: Two 203 mm (8 in.) trays.

e) Fiber Adapter

i. 12 Duplex Port Universal Adapter Strips LC Push-pull coupling with floating ferrule for positive locking and contact stability Ceramic ferrule and plastic housing for long term reliability.

ii. Duplex version with A and B marking as per TIA/EIA-568-B.3 – for ease of administration Available in PC (MM), SPC (SM) and UPC (SM) polish for maximum performance.

f) Fiber Pigtail

i. 1.5 Meter (6 ft.) LC Pigtail OS2 (48 Number)

ii. 100% optically tested against industry standards-ensures reliability

iii. High quality ceramic ferrule - provides low insertion loss and durability

iv. Insertion Loss: ≤ 0.3dB @ 1310nm

v. Return Loss: ≥ 50dB @ 1310nm

vi. Reflectance (dB): -20

vii. Telecommunication Standards: TIA 604 (FOCIS), TIA/EIA 492AAAE, IEC 61754, IEC 60793-2-10, IEC 61300-3-35, YD/T1272.1-2003, RoHS, ISO 9001, CE, REACH, WEEE Compliant

3.23 **OPTICAL FIBER TERMINATION FRAME (OTF) 12 CORE**

Supply, installation, testing and commissioning12Optical Fiber Termination Frame Rack Mount with LC adapter and LC SM 1.5-meterPigtail with following specification as per direction of the Engineer in charge.

a) Frame Factor : Rack Mount type

b) Adapter and Pigtail : LC type

c) General:

Low profile, takes up only one unit of rack Space. 1U = 45 mm (1.75 in.) Patch panel can be ordered in Gary or Black Universal Connector Panel and Strips allowing flexible and customized patch panel design. Mounted on a hinge, swings out to allow easy access to the back of the panel, from the front. Rugged design protects fiber terminations and fiber connectors Compatible with 203 mm (8 in.) Splice Organizer Tray, allows for splicing optical pigtails. Connector capacity: 12 X 1 (One strips) (up to 12 fiber with LC connectors). Splice Tray capacity: One (203 mm /8 inch.) tray.

d) Fiber Adapter :

12 Duplex Port Universal Adapter Strips LC Push-pull coupling with floating ferrule for positive locking and contact stability Ceramic ferrule and plastic housing for long term reliability. Duplex version with A and B marking as per TIA/EIA- 568-B.3 – for ease of administration Available in PC (MM), APC (SM) and UPC (SM) polish for maximum performance.

e) Fiber Pigtail : 1.5 Meter (6 ft.) LC Pigtail OS2 (48 Number)

i.100% optically tested against industry standards-ensures reliability

ii. High quality ceramic ferrule - provides low insertionloss and durability
iii. Insertion Loss: ≤ 0.3dB @ 1310nm
iv. Return Loss: ≥ 50dB @ 1310nm
v. Reflectance (dB): -20
vi. Telecommunication Standards: TIA 604 (FOCIS), TIA/EIA 492AAAE, IEC 61754, IEC 60793-2-10, IEC61300-3-35, YD/T1272.1-2003, RoHS, ISO 9001, CE,REACH, WEEE Compliant

3.24 **OPTICAL FIBER PATCH CORD**

Supply, installation of patch cord (single mode OFC) with following specification as per direction of the Engineer in charge.

a) Cable Length : 5 (Five) Meters
b) Connector Type : LC 18mm with Standard Boots
c) Polish Type : SMF: UPC-UPC; APC-APC
d) Connector Ferrule : Zirconia Ceramic
e) Cable Outside Diameter :Duplex: 1.6/2.0/3.0mm, Simplex: 0.9/2.0/3.0mm
f) Interchangeability : ≤0.2dB
g) Vibration : ≤0.2dB
h) Fiber Count : Duplex/Simplex
i) Cable Jacket : PVC (Riser/OFNR)/LSZH/Plenum (OFNP)

3.25 **COPPER CABLE UTP CAT- 6**

Supply, installation, testing and commissioning of UTP (unshielded twisted pair) Cat-6 cable with following specification or equivalent as per direction of the Engineer in charge.

a) Category : 4-pair unshielded twisted pair (UTP) cable
b) Conductor : 23 AWG (Solid)
c) Conductor Meta : Bare Copper
d) Jacket : FR PVC and LSZH type
e) Jacket thickness : 0.022 in (0.56 mm)
f) Outside diameter : 0.232 in (5.89 mm)
g) NVP (fastest pair @ 10 MHz): 69%

h) Maximum DC resistance : 7.61 ohms / 100 m

i) Maximum DC resistance unbalance: 3%

j) Mutual capacitance at 1 KHz: 5.6 nF/100 m

k) Maximum pulling tension : 25 lbs. (11.34 kg)

l) Weight : 25.6 lbs. /1,000 ft. (38.2 kg/km)

m) Operating temperature : - 4°F to 1 40°F (-20°C to 60°C)

n) Certifications : UL/CUL-listed, ANSI/TIA-568-C.2 category 6,Verified compliant with EIA/TIA standards by ETL, ISO/IEC 11 801: 2002 (edition 2) class E, CENELEC EN50173: 2002 (edition 2) category 6

3.26 **UTP PATCH CORD (CAT-6)**

Supply, installation of patch cord (Cat-6 UTP) with following specification as per direction of the Engineer in charge.

a) Length : Min. 3 Meter with RJ-45 Connectors at both ends

b) Conductors : 24 AWG solid copper

c) Cable Core : Four twisted pairs,

d) Insulation : PE

e) Filler Jacket : PVC and LSHZ

f) Boots : PVC moulded

g) Plug : Polycarbonate.

h) Dielectric strength : 1000 V RMS at 60 Hz for 1 minute

i) Voltage rating : 150 VAC maximum Current rating: 1.5 A

j) Maximum Insulation resistance: Min. 500 Mega-ohms

k) Contact resistance : Max.10 milli-ohms

l) Certifications : UL/ CUL-listed, ANSI/TIA-568-C.2, EIA/TIA Standards, ISO/IEC 11 801: 2002, EN50173: 2002

3.27 **HORIZONTAL WIRE MANAGER**

Supply, installation, testing and commissioning of Horizontal Wire Manager, 1U, Single-Sided under the following specifications or equivalent

a) Features: Standard 19" widely used industry standard. Rear cable manager for cable management.

b) Total Port Quantity: 12

c) Color: Black

d) Standards: TIA / EIA 568-C.2 Category 6, ISO/IEC 11801 Class E

e) Material Type: High-impact, flame retardant, thermoplastic, Powder-coated steel

f) Depth: 4.70 inch

g) Diameter Over Dielectric: Maximum 0.046 inch, Minimum 0.030 inch.

h) Height:1.75 inches and Width:19.00 inch

i) Insulation Resistance: minimum 500 Ohm

j) Regulatory Compliance/Certifications: RoHS 2011/65/EU, ISO 9001:2008

k) ETHERNET POE SURGE PROTECTOR

l) Interface Connections:2 x RJ45 Female Connectors

m) ESD/EMP Protection : Absorbing Transient Current with Response to Surge Voltage from 100V/s to 1kV/µs

n) DC Spark-Over Voltage: 90V @ 100V/s

o) Maximum Impulse Spark-Over Voltage: 700V @ 1kV/µs

p) Discharge Current : 10kA+

q) Maximum Insulation Resistance :1G ohm @ 50V

r) Maximum Capacitance : 1.0 pF @ 1 MHz

s) Data Line Protection : RJ45 10/100/1000 Ethernet

t) PoE Support : Yes

u) Shock and Vibration Certification : ETSI300-019-1.4 Standard

v) Operating Temperature : -30 to 65° C (-22 to 149° F)

w) Operating Humidity : 10 to 90% Noncondensing

CHAPTER 4 PABX

4.1 SINGLE LINE TELEPHONE SET

Supply installation testing & commissioning of single line telephone set for executive use with provision volume up+ down, redial, flash etc. including display with CID system complete. Suitable for use in tropical country like Bangladesh complete with required accessories and in conformity to specified codes & specification of international standards & CE / UL / CSA certified. Model & sample to be approved by the Engineer.

4.2 TELECOMMUNICATION CABLES

4.2.1 Twisted Pair Telecommunication Cables

For connection between telephone distribution board to telephone socket 1c-4x0.282 sq.mm (2 pair) PVC insulated & sheathed twisted pair telecommunication cables having dia of each core is 0.6 mm through concealed pipes should be used.

Cable manufacturer(s) must have valid test certificate from internationally accredited laboratory (like CPRI, KEMA etc) approved / accepted by the Engineer.

4.2.2 Jelly Filled Armoured Telephone Cable

Supply and installation of Jelly Filled armored Telephone Cable having copper dia 0.5mm, ccJ-20 pair cable for intercom networking in winch control house and open repair facility from the central PABX network of Naval base.

4.2.3 Co-axial Cables for Dish

Supplying & drawing of RG-11, PVC insulated & sheathed 75ohm impedance co-axial cables through concealed pipes.

Cable manufacturer(s) must have valid test certificate from internationally accredited laboratory (like CPRI, KEMA etc.) approved/accepted by the Engineer.

4.3 TELEPHONE MAIN DISTRIBUTION FRAME

Supply and installation of 100pair telephone main distribution frame made of 16 SWG sheet steel complete with connecting strip everything complete and all required accessories of reputed manufacturer such as TP Link or equivalent, as per drawing, specification and instruction of the engineer-in charge. box as per drawing, specification and instruction of the Engineer-in charge. Main Telephone Distribution Frame with all connecting accessories

4.3.1 Intermediate Telephone Distribution Frame

Supply and installation of 20 pair Intermediate Telephone Distribution Frame with all connecting accessories made of 16 SWG sheet steel complete with connecting strip everything complete and all required accessories of reputed manufacturer such as TP Link or equivalent, specification and instruction of the Engineer-in charge. Separate ODF will be installed in the open repair facility for communication in ship and maintenance team.

4.3.2 **TV/dish junction box**

16 SWG Sheet steel enclosed, dust & vermin proof, free standing surface /concealed type Wall mounting indoor type TV/dish junction box complete with of following sizes with connecting strip and all required accessories such as insulator, screw, rubber bushing, Rawl plug etc. as per drawing, specification and instruction of the Engineer-in-charge.

1 to 4-way Junction box. (in RG-11 & out RG-11 & RG-6)

CHAPTER 5 AIR CONDITIONING SYSTEM

5.1 GENERAL SPECIFICATION

Supply, installation and commissioning of air Conditioning system: Remote controlled split type with ceiling mount cassette, flush with false ceiling, air-conditioner unit including all copper piping, refrigerant, insulation, fitting, fixing and commissioning as per the satisfaction of the Engineer/ PIT.

Standard Specifications per machine unit:

a) Cooling capacity: 24000BTU/hr, 36000 BTU/hr, (2/3 ton, as mentioned in the detail drawing of winch control and power supply system)

b) Type: Split cassette type.

c) Operation: Wireless remote.

d) Moisture removal: 5.0 (I/h)

e) Room air Circulation (indoor): 1700 cum/hr.

f) Room air Circulation (indoor): 5000 cum/hr.

g) Input power: 380-415 Volt, 3 phase 50 Hz

h) Running current: 9.0 Amp max.

i) Power Consumption: 5.25 kW max.

j) Dimension (indoor): 300x850x850(May customized for different Ton capacity)

k) Dimension (outdoor):1200x1000x500 (May customized for different Ton capacity)

l) Connection pipe size (large/small): 9-10 / 19-20 mm.

m) Pipe length/height difference: 50m/30m

n) Permissible range of outdoor temperature: 50ºC

o) Brands are General made in Japan, Fujitsu, made in Japan / Daikin, made in Japan / Mitsubishi, made in Japan/ Carrier made in USA/ Hitachi, made in Japan.

5.2 **OUTDOOR UNIT / CONDENSING UNIT**

(i) Type: Compact weather proof outdoor type condensing unit

(ii) Compressor: Hermitically sealed reciprocating / rotary compressor.

(iii) Refrigerant: Internationally accepted and recommended and most commonly used gas (CFC free)

(iv) Blower motor: Well-balanced type direct driven centrifugal type blower fan.

(v) Power supply:

(i)200-250 V, single phase, 50 Hz. AC supply [up to 30000BTU/HR]

(ii) 400-440 V 3-phase, 50 Hz. AC supply [above 30000 BTU/HR]

(vi) Condensing pipe / coil: Made of copper

(vii) EER:Minimum8.5 [EER = BTU/HR] WATT

(viii) Others features:

a) Well balanced in all respect having interlock with the fan coil unit.

b) Compressor dully equipped with vibration isolator, thermostatic and overloads controls, magneticcontactors and all other standard accessories complete.

c) Refrigerantcopperpipe [Fromoutdoortoindoorunit]withthermalinsulation, refrigerantcharging arrangementetc.[Min. length10m]

d) Reqd.sizePVCinsulatedandsheathedcablewithECCthroughwatergradePVCpipefromoutdoortoindoorunit.

5.3 **INDOOR UNIT / FAN COIL UNIT**

a) Direct expansion system fan coil unit with well-balanced direct driven centrifugal type fan.

b) Fancy and adjustable air circulating louver grill, removable and washable type filter.

c) Condensing water drain out PVC flexible pipe with necessary insulation

d) Thermostatic switch and remote-control switch.

5.4 STANDARDS

Major component shall be manufactured as per relevant international standard and code.

5.5 DOCUMENTS

Manufacturing company shall have the following certificate-

a) ISO-9001, 2008

b) CE / UL certification

5.6 WARRANTY

The bidder should provide the guaranty of compressor for at least 1 years and free service with spares for 1 years from the date of commissioning and it should be obtained from the air cooler selling agency.

5.7 AIR CONDITIONING UNIT TESTING

The following test will be carried out from the lot as described in below chart:

a) Cooling BTU capacity test
b) EER test
c) Air flow test

CHAPTER 6 FIRE DETECTION ANDFIRE FIGHTING HYDRANT SYSTEM

6.1 GENERAL INSTRUCTION

In modern era, fire hazard is a big concern for any type of facility. In ship docking and repair facility, there will be huge arrangement of maintenance and repairing works of different kinds of ship. For Different repairing facility will be used as a place of large number of industrial equipment. So, there will be many sources of fire hazard and people are very much likely to be affected by the consequences. To avoid any kind of injury and damage of equipment we must arrange necessary fire detection and firefighting system in the dockyard area. The bidder will provide modified working drawing in addition to proposed tender drawing as per NFPA relevant code before workmanship. The drawing proposed from BN is only to give direction for the tenderer. Final construction drawing must be provided by the bidder to BN.

6.2 FIRE STANDARD

Following fire standard should be maintaining during preparation of construction design and implementation on site by the bidder:

a) NFPA 1Fire Code

b) NFPA 4Standard for Integrated Fire Protection and Life Safety System Testing

c) NFPA 10 Standard for Portable Fire Extinguishers

d) NFPA 13 Standard for the Installation of Sprinkler Systems

e) NFPA 14Standard for the Installation of Standpipe and Hose Systems

f) NFPA 17 Standard for Dry Chemical Extinguishing Systems

g) NFPA 17A Standard for Wet Chemical Extinguishing Systems

h) NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

i) NFPA 22 Standard for Water Tanks for Private Fire Protection

j) NFPA 72 National Fire Alarm and Signaling Code

k) NFPA 80 Standard for Fire Doors and Other Opening Protective's

6.3 FIRE EXTINGUISHER: DRY CHEMICAL POWDER TYPE

Multipurpose ABC dry chemical powder stored pressure type with manometer system fire extinguisher suitable for repeated use complete with wall bracket, CO_2cartridge, easy refilling system etc. as per sample accepted and approved by the Engineer/ PIT.

Mono Ammonium Phosphate based 40% ABC dry chemical agent andhasmoisture-proof, anti-caking properties. Working pressure: 12 BAR minimum and Test pressure: 25 BAR minimum. Proper fire rating (as per NFPA 10) according to the capacity of the extinguisher. Manufacturer certificate shall have to be submitted if needed. Also sample of the dry chemical powder will be tested by the proper authority in Bangladesh if needed.

6.4 FIRE EXTINGUISHER: FOAM TYPE

Supply & fixing of foam type with manometer system fire extinguisher suitable for repeated use complete with wall bracket, easy refilling system etc. as per sample accepted & approved by the Engineer in Charge. Working pressure: 12 BAR minimum & Test pressure: 25 BAR minimum. Proper fire rating (as per NFPA 10 / BS / EN) according to the capacity of the extinguisher. Manufacturer's certificate shall have to be submitted if needed. Also sample of the foam type extinguisher will be tested by the proper authority in Bangladesh if needed.

6.5 PILLAR HYDRANT

Supply and installation of cast Iron body double headed pillar hydrant complete with 2 (two) nos. cast brass made controllable outlet ofØ65mm with female instantaneous outlet, Inlet shall be Ø100mm flanged end. The hydrant shall be suitable to withstand test pressure of 300 psi (minimum). Color of the unit shall be red / approved by the manufacturer or as per code. Pillar hydrant shall be BS standard.

6.5.1 Fire Water Pump – Diesel Engine Driven

6.5.1.1 General

Supply and installation of 500GPM, 12BARdiesel engine driven fire pump complete with all related and essential accessories. The pump shall be designed and installed in accordance with globally accepted international standard. Each unit shall be tested and UL listed/FM approved.

Type: Pumps shall be of the non-overloading, centrifugal, and horizontally split, double suction type with suction and discharge connections in the lower half of the casing, allowing removal of the rotating element without disturbing the pipe connections and operating at not over 3000 rpm. Pumps shall be selected for a total efficiency of not less than 65%. Pump performance curves shall be submitted for approval together with the pump technical data.

6.5.1.2 Diesel Engine

The diesel engine brake horsepower shall be listed by UL / approved by FM suitable for rated pump capacity. The engine shall rate at standard conditions for 152.4m (500 ft) above sea level at 29.4°C by the testing laboratory. The engine shall be of a reputed manufacturer from which spare parts can be obtained locally. The engine shall be provided with an adjustable governor capable of regulating engine speed with a range of 10% between shut-off and maximum load conditions of the pump. The governor shall be set to maintain the rated pump speed at maximum pump load.

6.5.1.3 Battery and Charger

The engine shall be provided with two maintenance free storage battery units, each having sufficient capacity, at 5°C (41°F) to maintain cranking speed recommended by the engine manufacturer through a 6 min cycle. Two means for recharging shall be provided. One shall be the generator furnished with the engine. The other shall be an automatically controlled charger taking power from the facility power supply.

6.5.1.4 Fuel Tank

The fuel tank shall be as per manufacturer's recommendation with rigid frame. Fuel tank shall have capacity at least equal to 1 gallon (3.79 litre) per horsepower (746 Watt) plus 5% volume for expansion. Fuel tank shall be equipped with fuel supply line, return line, fill, drain, overflow, air vent and sight glass.

6.5.1.5 **Cooling System and Engine Exhaust Pipe**

The engine shall be provided with close circuit cooling water circulation system shall be provided. The exhaust shall be galvanized steel sized in accordance with the manufacturer’s recommendations. The exhaust pipe shall be galvanized steel sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be as short as possible.

6.5.1.6 **Controller**

The controller shall be UL listed / FM approved, completely assembled and wired from the factory. The controller shall be 12 volt / 24 volt. and shall be complete with all necessary component and accessories.

The controller shall be operable automatically on sensing low pressure in the system and shall be provided with a pressure-actuated switch having independent high and low calibration adjustments. The switch shall be responsive to water pressure in the fire protection system. The pressure-sensing element of the switch shall be capable of momentary surge pressure of 20.68 bar (300 psi) without losing its accuracy, suitable provision shall be made for relieving pressure to the pressure actuated switch to allow testing of the operation of the controller and the pumping unit.

Country of origin: AUSTRALIA / CANADA / JAPAN / USA / European countries or their licensed manufacturing units located globally.

6.5.2 **Fire Water Pump – Electric Motor Driven**

Supply and installation of electrically driven centrifugal type end suction, vertical discharge fire water pump manufactured according to globally accepted international standard shall be complete with skid mounted, coupled with motor, safety cover etc. Motor shall be 500 GPM/ 12BAR/ 420V/3 phase/ 50 HZ/ 2900 rpm / Class F insulation / Encloser IP55 [as per pump manufacturer's recommendation / performance curve of the pump]. The pump shall have a capacity to handle 500 US GPM of water against a head of 120 m (394 feet).

Country of origin: AUSTRALIA / CANADA / JAPAN / USA / European countries or their licensed manufacturing units located globally.

6.5.3 Jockey Pump (Pressure Maintenance Pump)

Supply, installation of multistage jockey pumpmanufactured according to globally accepted international standard or fire hydrant system to keep a certain pressure in water distribution system. Capacity of the pump shall be 75 lpm (20 US GPM) against a head of 80-120 meter (263-394 feet) of water. Pump shall be complete with motor suitable to meet performance curve of the pump. The motor shall be 420V / 3 phase/ 50 HZ / 2900 rpm. [3 kw minimum but need to conform to NFPA 20].

6.5.4 Pump Control Panel for Motor Driven Fire and Jockey Pumps

Supply, installation of fire and jockey pump control panel complete with MCCB / MCB / magnetic contactor / on-off push switch / indication lamp for phase indication, run, trip mode / ampere meter / volt meter / overload selector switch / phase failure protection device / dry operation protection device / volt guard / connector block / bus-bar / CT of rated capacity / ventilation fan / buzzer / cable lugs / and all other accessories. The panel shall be well dressed in side for safety purpose and for looking good.

The panel shall be suitable for 3-phase 400 ± 5%-volt 50Hz power supply. The panel shall with auto-manual mode to operate the pumps controlled by pressure sensors. For fire pump the panel shall have option to start the pump automatically by stop shall be manual. For jockey pump the panel shall be suitable to start-stop the pump automatically controlled by pressure sensor.

Enclosure of the panel shall be made with 16 SWG sheet steel and shall be painted with powder coating of red color approved as Fire code. Door of the panel shall be swing type with locking arrangement. Knob of main MCCB shall be extended in front screen. The panel shall be wall mounted type with fixing arrangement properly.

The panel shall be locally assembled in accordance with standard code of practice as NEMA / IEC / VDE / BS standards comprising of required capacity.

Country of origin of main components (MCCB / MCB / magnetic contactor / overload): AUSTRALIA / JAPAN / MALAYSIA / SINGAPORE / SOUTH KOREA / USA / European countries / or their licensed manufacturing units located globally.

6.6 FIRE HYDRANT UNIT (65mm dia.):

Each 65mm (2½") dia fire hydrant unit shall be complete with the following components and accessories.

6.6.1 Hose Angle Valve (Landing Valve): 65mm (2½") Dia.

Supply and installation of Hose angle valve / landing valve of 65mm (2½") dia. shall be made with brass / bronze with instantaneous female outlet. The valve shall be UL Listed /FM Approved and working pressure shall not be less than 10kg/cm². Inlet shall be threaded end type, shall be installed inside the hydrant cabinet.

Country of origin: MALAYSIA / SOUTH KOREA / TAIWAN / USA / European countries or their licensed manufacturing units located globally.

6.6.2 FIRE HOSE: 1½" dia

Supply & installation of Single Jacket fire hose of 38mm dia 30 meter long with hose rack frame & nipple suitable to install inside the hydrant cabinet. The hose shall conform to NFPA 1961. The hose shall be UL Listed / FM approved. Working pressure & burst test pressure shall be not less than 200 psi & 600 psi respectively, shall be made with special quality EPDM rubber as internal lining, suitable to withstand heat and polluted water, heat and abrasion resistance. Jacketing shall be made up of 100% polyester for extra strength. Hose shall be 30meter long in a single length and shall be with aluminum alloy body instantaneous male coupling in one end other end with instantaneous female coupling. Color of the hose pipe shall be white.

6.6.3 Jet / spray NOZZLE: 1½" dia

Supply & installation of UL listed / FM approved Jet/ spray nozzle having 40mm dia with male instantaneous coupling or shall be connected to the male/ female instantaneous coupling of 38mm hose pipe. The nozzle shall be operable in three modes: jet - spray - shut off. The nozzle shall be light weight and easy operable. Construction of the nozzle shall be of brass &working pressure shall be not less than 100 psi. Test pressure shall be minimum 230 psi(16 bar) . Flow Capacity of nozzle shall not be less than 100 GPM @ 100 psi. Nozzle shall be installed inside the cabinet.

6.7 BLACK STEEL PIPE ERW, 40 SCHEDULES:

Supply and installation of black steel pipe ASTM A53 ERW, 40 schedule. The pipe work shall be included with welded type tee, elbow, reducer etc. and also hangers / supports etc completed. Pipe work (over ground) shall be painted with red oxide primer. Underground pipes should be laid after wrapping with PVC tape. Pipe wall thickness shall be as per mentioned for different diameters.

SL NO	Dia	Wall Thickness
1.0	200mm	8.2mm
2.0	150mm	7.1mm
3.0	100mm	6.0mm
4.0	65mm	5.2mm
5.0	50mm	3.9mm
6.0	40mm	3.7mm
7.0	25mm	3.4mm
8.0	20mm	2.9mm
9.0	12mm	2.8mm

6.8 VALVES and FITTINGS

6.8.1 Gate Valves and Anti Vortex plate

Supply and installation of valves and fittings complies with ANSI, flange / groove type, temperature range: 0^0C-80^0C; working pressure: 200 PSI minimum, valve body as per ASTM A536, 65-45-12 standard, UL / FM approved.

6.8.2 Flexible Joint

Supply and installation of flexible joint complies with ANSI, temperature range: 0^0C -80^0C; working pressure: 13.79 bar (200 psi) minimum, valve body as per ASTM A536, 65-45-12 standard, UL / FM approved.

6.8.3 Ball Valves Class: Pn20, Ul / FM Approved.

Supply and installation of ball valves complies with ANSI, temperature range: 0^0C - 80^0C; working pressure: 20.7 bar (300 psi) minimum, valve body as per ASTM A536, 65-45-12 standard, UL / FM approved.

6.8.4 Pressure Gauge: (Ul Listed / FM Approved)

Supply and installation of 90mm-100mm (3.5" - 4") dial type pressure gauges including supply of all accessories and consumable. The range shall be 0-17.24 bar (0-250 psi). UL/FM approved.

6.8.5 **Pressure Switch**

Supply, installation and testing of pressure switch complete with sensing element, enclosure material, 15 mm NPT pressure connection, direct mounting electrical connection, other material etc. accepted / approved by the Engineer/ PIT

6.8.6 **Pressure Relief Valve**

Supply, installation and testing of Ø80 mm pressure relief valve to automatically relieve excess pressure in fire protection pumping systems. Valve body as per ASTM A536 65-45-12 and available pressure relief range 6.9~20.68 bar (100-300 psi). Inlet / outlet shall be flanged / threaded end type.

6.8.7 **Auto Air-Vent Valve**

Supply and installation of auto air vent valve ofØ25mm with Ø25mm dia inlet BSP, bronze made with rubber ball and seat. The valve shall be suitable to release air from the fire hydrant pipes. (Shall be suitable to withstand pressure upto 10kg/cm^2).

6.8.8 **Flow Switch**

Supply and installation of 50-100 mm dia flow switch of leaf type suitable for installation within 65mm and 40mm dia water hydrant pipe. The flow shall sense flow of water within pipe and send signal to water flow monitoring panel. Flow switch shall be under control of water flow supervisory panel to ensure the hydrant operation. Power supply shall be 24VDC. The flow switch shall be UL listed.

6.8.9 **Pressure Reducing Valve: 40mm dia**

Supply and installation of pressure reducing valve of Ø40mm (1½"), brass body, screwed end type, shall be used with Ø40mm internal hydrant unit (where to reduce high pressure is necessary). Valve body shall be made with hot pressed brass, seat of stainless steel ANSI304 shall be suitable for 80°C. Initial pressure shall be 15 BAR, adjustable final pressure shall be 0.5 BAR (min), 7 BAR (max)

6.9 **WASTE CONE**

Supply & installation of 100 x 150 mm (4 x 6 inch) dia flange type waste cone. Two sight glasses extending from the center of the waste cone allow users to observe the flow of water and ensure that the system's pumps and other components are working correctly. The size of the waste cone shall be selected as per main relief valve out line: UL Listed / FM approved.

6.10 WATER FLOW MONITORING PANEL

Supply and installation of water flow monitoring panel to monitor water flow of hydrant units. After receiving close contact through flow switches indication will be at panel and buzzer will be activated. Power supply: 230VAC ± 10%. Network power shall be 24VDC. The panel shall be conventional type, complete with LED indication, keypad, trickle charger, rechargeable batteries etc.

6.11 TEMPER SWITCH

Supply & installation of Temper Switch to monitor the open position OS&Y type gate valve as per NFPA 20. The temper switch shall be mounted conveniently to OS&Y Gate Valves ranging in size from 2"- 8", UL Listed / FM approved.

Temper Switch for 2"- 8" OS&Y Gate Valve

6.12 ADDRESSABLE TYPE FIRE ALARM CONTROL PANEL

Supply and installation of addressable type fire alarm control panel complete with following basic options. Master controller assembly / CPU shall be suitable with port to add voice alarm system / fire fighter telephone system / Printer / remote annunciator etc. FACP must be comply with internationally accepted standard. Control units for fire -protective signaling systems.

Addressable fire alarm control panel shall be complete, non-coded, addressable, microprocessor based with initiating devices, notification appliances, and monitoring and control devices.

6.12.1 Annunciation

Operation of alarm and supervisory initiating devices shall be annunciated at the FACP indicating the location and type of device.

6.12.2 Environmental Compensation

The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

6.12.3 Programmable Sensitivity

Photoelectric smoke sensors shall have various sensitivity levels ranging from (±) 0.2% up to 3.7%, programmed and monitored from the FACP.

The FACP shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

6.12.4 **Battery**

a. Sealed lead-acid. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 5 minutes.

b. Power supply (input power) shall be 240VAC. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.

c. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.

d. The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

e. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

f. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

g. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

h. Wiring diagrams, Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.

i. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

j. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, sensor, and auxiliary control circuits.

k. Alarm silence, system reset and priority to reset global and individual point acknowledge. Set system time and date and clear event log, individual point access for control or parameter revisions.

l. Each RS port shall be capable of supporting and supervising a remote printer; the FACP shall support as many as remote displays. The fire alarm control panel shall support five RS ports.

m. Cabinet shall be lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

n. Operation and maintenance data for inclusion in operating and maintenance manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

o. Operating temperature range: 32° to 120°F (0° to 49°C)

p. Operating humidity range: Up to 93% RH, non-condensing @ 90° F (32° C) maximum

q. Approvals: UL listed / FM approved.

6.13 **ADDRESSABLE TYPE PHOTOELECTRIC SMOKE DETECTOR**

Supply & installation of addressable type photoelectric / Optical smoke detector c/w standard Base. The detector shall be self-restoring: detectors do not require resetting or readjustment after actuation to restore normal operation. No special tools shall be required to

remove head once it has been connected with base. Removal of the detector head shall cause a trouble signal at the control unit. Except false ceiling, detector base shall be fixed with gang box in any other ceiling as per manufacturer instruction.

In alarm condition, the sensor LED shall be on steady or have Bicolor (green/red) status LED. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a wrong / programmeddevice, the control unit shall operate with the installed device at the default alarm settings for that sensor but shall indicate a programmed device trouble condition.

- ✓ Detector shall have listed Spacing Capacity of 30 Feet.
- ✓ Detector shall have at least two level of dirty detector warning.
- ✓ Detector shall have nonvolatile memory to store the data of Sensitivity values, troubles, etc.
- ✓ Detector having a unique identification shall communicate status to the FACP. Detector shall have at least two sensitivity settings.
- ✓ Removal of the sensor head for cleaning shall not require the setting of addresses.
- ✓ Operating ambient temperature range shall be minimum: 0° to 45°C(Minimum)
- ✓ Shall be suitable for humidity range: 10% to 95% RH
- ✓ Housing color shall be Frost White or equivalent.
- ✓ Smoke sensor ambient ratings: Air velocity (Minimum) 0-2000 ft/min (0-610m/min) for non-Optical Smoke Detector
- ✓ Approvals: UL listed / FM approved

6.14 **ADDRESSABLE TYPE HEAT DETECTOR:**

Supply & installation of addressable type heat detector with the combination of fixed-temperature and rate-of-rise heat detection.

- ✓ The detector shall be self-restoring: detectors do not require resetting or readjustment after actuation to restore normal operation.
- ✓ No special tools shall be required to remove head once it has been connected with base. Removal of the detector head shall cause a trouble signal at the control unit.

- ✓ Except false ceiling, detector base shall be fixed with gang box in any other ceiling as per manufacturer instruction. In alarm condition, the sensor LED shall be on steady or have Bicolor (green/red) status LED. Detector shall have listed Spacing Capacity of 50 Feet.
- ✓ The heat sensors of fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 130°F or 140°F (Minimum). Sensor rate-of-rise temperature detection shall be selectable at the FACP for 15° F per minute (Minimum).
- ✓ Detector having a unique identification shall communicate status to the FACP.
- ✓ Removal of the sensor head for cleaning shall not require the setting of addresses.
- ✓ Detector shall have nonvolatile memory to store the data of Sensitivity values, troubles, etc.
- ✓ Operating ambient temperature range shall be: 0° to 45°C(Minimum)
- ✓ Shall be suitable for humidity range: 0% to 93% RH Non-Condensing (Minimum)
- ✓ Housing color shall be frost white.
- ✓ Approvals: UL listed / FM approved

6.15 **ADDRESSABLE MANUAL PULL STATION (MPS)**

Supply & installation of addressable type manual call station of red color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

- ✓ Shall be with compact construction, suitable to electronics module enclosure minimizes dust infiltration. Allows mounting in standard electrical boxes. Screw terminals for wiring connections.
- ✓ Activation of the MPS will require a firm downward pull to activate the alarm switch. The pull lever latches into the alarm position and remains extended out of the housing to provide a visible indication.

- ✓ Operating ambient temperature range shall be: 0° to 45°C(Minimum)
- ✓ Humidity range: 93% RH (minimum) at 100°F (38°C)
- ✓ Housing color shall be red with white raised lettering. Housing and pull lever shall be made with lexan polycarbonate or equal.
- ✓ The MPS shall be semi-flash / surface mount type.
- ✓ Approvals: UL listed/FM approved.
- ✓ Addressable manual pull station: Single action
- ✓ Addressable manual pull station: Double action

6.16 **ADDRESSABLE NOTIFICATION DEVICE (HORN WITH STROBE)**

Supply & installation of addressable type audible horn with strobe for notification purpose shall contain an electronic module and a selectable address setting.

- ✓ The device shall be suitable to program the high / low setting of the audible (horn) appliances. The horn shall be red color with / without "FIRE" lettering.
- ✓ Addressable horn shall be UL listed / FM approved. The horn shall be suitable to produce sound pressure level of 89 dBA @ 24VDC at low level as per NFPA Standard. The horn shall suitable to mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
- ✓ Shall have suitable operating ambient temperature range: 0° to 45°C (Minimum)
- ✓ Humidity range: Minimum 93% RH at 100°F (38°C)
- ✓ Approvals: UL listed / FM approved.
- ✓ The Strobe shall be selectable at 15, 30, 75, or 110 cd

CHAPTER 7 HIGH MAST LIGHTING SYSTEM

7.1 OVERVIEW

This specification covers the technical requirements of design and supply in well packed condition of high mast lighting structures and control gears for movement / maintenance of light fittings. The scope shall also include the erection including installation, testing and commissioning of the automatic lifting system.

7.2 GENERAL INSTRUCTIONS

The supplier is to consider the followings for the purpose of design.

a) Masts shall be of unipolar (single pole) structure. Special consideration shall be taken in respect of lamp replacement, operation and maintenance.

b) Meteorological Data

c) 400W LED lamps shall be used.

d) The environment is corrosive. Selection of all materials shall be suitable for the above environment.

e) The height of mast shall be 30M.

f) Each mast will have at least 20luminaries or more (if required 400W minimum)

g) Necessary structural drawing showing the piles, footing, anchor bolts etc. details must be submitted and approved before installation of the high mast pole.

7.3 SCOPE

The scope of this job covers the design, supply and erection of 06 no’s 30M high mast flood lighting towers, including the installation, testing and commissioning of an automatic lifting system for raising and lowering the lights during maintenance.

7.4 APPLICABLE STANDARDS

The following shall be the Reference Standards for the loading of the high mast:

BS 4360 Grades of MS Plates

BS 5135 Welding

BD 729 Galvanizing

7.5 HIGH MAST LED LIGHT

Highly efficient LED lights must be used for mast lighting. Technical requirement is listed below:

a) Light efficacy of up to 140 lm/W with median life 1,00,000 hour

b) Each modular LED engine is composed of 92 high performance LEDs with

c) correlated color temperature as per ANSI/NEMA bin Neutral White,

d) 4000 Kelvin nominal (3985 +/- 275K or 3710K to 4260K).

e) A minimum CRI of 70 enables better color perception therefore creates improved visual acuity.

f) The LED array will be indexed with a UV stabilized optical grade polymer refractor lens to enhance light extraction, ensure uniform lighting and meeting the veiling luminance (glare) requirements.

g) Entire optical assembly will be rotatable, allowing for precision asymmetric distribution. All optical distributions have a U0 rating which means no up light and all of the light is directed downward on the roadway or the field where it is needed.

h) External house side shields for the luminaries and internal house side shields for LED engines are required to prevent light trespass.

i) Highly efficient LED packages will be assembled on a thermally efficient MCPCB (metal core printed circuit board) with robust interconnects provided by the high reliability solder joints. These creep resistant solder joints maintain excellent shear strength that allows them to survive a great number of thermal cycles even under high CTE mismatch conditions.

j) The LED board must be attached to an aluminum heat sink which is mounted to the die cast luminaries housing. The modular heat sink and aluminum luminaries housing combine to provide high efficiency thermal transfer of the

waste heat generated at the LED junction. Minimum Gaps between the modules needs to facilitate natural air flow which drives convective cooling of the light engines.

k) The LED light fixture must be engineered to stand strong in extreme weather and environmental conditions. Made of a low copper aluminum alloy (A360), the heavy-duty luminaries housing must provide excellent mechanical strength and corrosion resistance. The modular heat sink will be built from anodized 6063-T5 aluminum and provides durable protection for the light engine. Rugged system construction and strong metallurgical bonding between the MCPCB and LEDs will make mechanically strong to survive wind- and vehicle-induced vibration.

l) The luminaries must be tested for 3G over 100,000 cycles by an independent lab and meets the ANSI C136.31, American National Standard for Roadway Luminaire Vibration specifications for bridge/overpass applications.

m) The aluminum housing will be finished with a polyester powder coat paint (4 mils/100 microns) with ± 1 mils/24 microns of tolerance. The thermosetting resin provides superior discoloration resistance in accordance with the ASTM D2244 standard, as well as optimal luster retention per the ASTM D523 standard.

n) The luminaire has been tested to withstand 3,000 hours of salt spray exposure as defined in ASTM Standard B117. Modular LED engines are sealed to provide IP66 level ingress protection against water and dust penetration. Seals and sealing devices are made and/or lined with EPDM and/or silicone and/or rubber. All exposed screws are made of stainless steel for high corrosion resistance.

o) The electronic driver operates on auto adjusting universal voltage input from 120 to 277 VAC or 347 to 480 Vac rated for both application line to line or line to neutral.

p) A built-in power factor correction circuit maintains a high-power factor of minimum 0.9 while suppressing the harmonic current within the 20% maximum THD limit.

q) The on-board thermal protection module automatically reduces LED drive current to prevent overheating when the system temperature hits the upper limit. The driver is also protected against damage resulting from electrical shorts and overloaded circuits. The constant current driver is capable of 0-10V dimming which provides compatibility with many available controls such as photocells, motion sensors, and digital wireless control systems. Optional 5-pin and 7-pin NEMA twist lock receptacles are available to accommodate a twist lock control node, photoelectric cell or a shorting cap.

r) The driver has standard built-in surge protection of 2.5kV (min). An integrated 10kV/10kA surge protector is designed to protect luminaire against common (line-to-ground) and differential (line-to-line) mode surges.

s) The driver is housed in a separated electrical compartment which is IP65 sealed with pre-installed gasket. The complete separation of the driver compartment from LEDs prevents LED thermal impact that can compromise driver's service life.

t) Electrical connection of the luminaire is done using a terminal block connector 600V, 85A for use with #2-#14 AWG wires from the primary circuit, located inside the housing. A time delay or slow blow fuse is recommended to avoid unnecessary and unwanted fuse blowing that can occur with fast acting fuses due to the inrush current that occurs with electronic drivers.

u) A single screw with sealing washer, hinged, removable door opens upward to provide access to the electrical compartment. Door is secured to prevent accidental dropping or disengagement. A bird guard seals around tenon and protects the electrical compartment against birds and similar intruders.

v) The luminaire is designed to fit on a 2 3/8" (60mm) O.D. (2" NPS) by 5 1/2" (140mm) minimum long tenon. A zinc plated clamp which is fixed by 4 zinc plated hexagonal bolts 3/8-16 UNC provides ease of installation and allows step adjustment of +/ 3° tilt in 3° increments.

w) Country of origin: UK/ USA/France/Finland/Germany

x) Brand: Phillips or any equivalent brand to be proposed by the bidder

7.6 AVIATION OBSTRUCTION LIGHTS

Suitable Aviation Obstruction Lights of reliable design and reputed manufacturer shall be provided on top of each mast.

7.7 EARTHING TERMINALS

Suitable earth terminal using 12mm dia stainless steel bolts shall be provided at a convenient location on the Mast base, for lightning and electrical earthing of the mast.

7.8 FEEDER PILLAR

Each mast shall be provided with a feeder pillar fabricated out of 14 SWG CRCA sheet and finished with two coats of red oxide primer and grey enamel paint of shade 631 of IS5. The feeder pillar shall comprise of incoming 32 amp TPN Switch Fuse Unit, HRC fuses, copper busbar, incoming / outgoing terminals and control for the power motor. Feeder pillar shall be mounted on suitable foundation near to the mast.

7.9 INCOMING POWER CABLE

A cable of size 4 x 10 sq. mm Aluminum conductor, Armored cable for power supply and 4 x 1.5 sq. mm Copper ConductorArmored cable for motor supply shall be provided from feeder pillar to the base compartment of the high mast. Cable shall be taken to the base compartment of the high mast through the provision made in the foundation. Power cable of suitable size up to the feeder pillar from supply point shall be provided by bidder.

7.10 TECHNICAL SPECIFICATIONS

7.10.1 Structure

The High mast shall be of continuously tapered, polygonal cross section, at least 8 sided or more, presenting a pleasing appearance and shall be based on proven In- Tension design conforming to standards, to give an assured performance and reliable service.

The mast height shall be 30 meters, with minimum diameters of 225mm at the top and 600-900 mm at the bottom. Minimum plate thickness of bottom section shall be 10mm and other sections 6mm. The PCD of the mast flange shall be minimum 900 mm. The structure shall be suitable for wind loading. All the frame surface both interior and exterior must be treated with **HOT DIP GALVANIZED process**.The bidder may provide necessary modified drawing of the high mast before authority of BNS dockyard.

7.10.2 Construction

The mast shall be capable of safely withstanding the strong winds prevailing at site. The deflection at the top during heavy storm periods shall therefore be considered in the design and the mast designed in such way that the above deflection during worst periods is kept to a minimum value.

The mast shall be fabricated from special steel plates, conforming to BS-EN10-025, cut and folded to form a polygonal section as stated above and shall be telescopically jointed and fillets welded. The welding shall be in accordance with BS:5135.

The procedural weld geometry and the workmanship shall be exhaustively tested on the completed welds. The 30-meter size mast shall be delivered in sections, and shall be jointed together by slip-stressed-fit method at site. No site welding or bolted joint shall be done on the mast. The minimum overlap distance shall be 1.5 times the diameter at penetration.

The mast shall be provided with full penetrated flange which shall be free from any lamination or incursion. The welded connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with supplementary gussets between the bolt holes to ensure elimination of helical stress concentration. For the environmental protection of the mast, the entire fabricated mast shall be hot dip galvanized, internally and externally, having a uniform thickness of 65 microns.

Required footing will be with3 No’s 400x400 Precast pile of 18.5meter and pile cap as specified in pile drawing. In addition, minimum 1350mm long M32 Anchor with end bar and bolts must properly designed to withstand 210km/h wind speed.

7.10.3 Door Opening

An adequate door opening shall be provided at the base of the mast and the opening shall be such that it permits clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch. The door opening shall be complete with a close fitting, vandal resistant, weather proof door, provided with a heavy duty double internal lock with special paddle key. The door opening shall be carefully designed and reinforced with welded steel section, so that the mast section at the base shall be unaffected and undue buckling of the cut portion is prevented.

7.10.4 **Dynamic Loading for the Mast**

The mast structure shall be suitable to sustain an assumed maximum reaction arising from a wind speed as per BNBC (three second gust), and shall be measured at a height of 10 meters above ground level. The design life of the mast shall be a minimum of 35 years.

7.10.5 **Lantern Carriage**

7.10.5.1 **Fabrication**

A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fitting and control gear boxes. The Lantern Carriage shall be of special design and shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets. The Lantern Carriage shall be so designed and fabricated to hold the required number of flood light fittings and the control gear boxes, and also to have a perfect self-balance.

The Lantern Carriage shall be fabricated in two halves and joined by bolted flanges with stainless steel bolts and plastic lock type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The entire Lantern Carriage shall be hot dip galvanized after fabrication.

7.10.5.2 **Junction box**

Weather proof junction box with IP55 enclosure, made of Cast Aluminum shall be provided on the Carriage Assembly as required, from which the inter- connections to the designed number of the flood light luminaries and associated control gear fixed on the carriage shall be made.

7.10.5.3 **Raising and Lowering Mechanism**

For the installation and maintenance of the luminaries and lamps, it will be necessary to lower and raise the Lantern Carriage Assembly. To enable this, a suitable Winch Arrangement shall be provided, with winch fixed at the base of the mast and the specially designed head frame assembly the top.

7.10.5.4 **Winch**

The winch shall be of completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when

not in use, gravity activated PAWLS. Individual drum also should be operated for fine adjustment of lantern carriage. The capacity, operating speed, safe working load of the recommended lubrication and serial number of the winch shall be clearly marked on each winch.

The gear ratio may be according to manufacturer's standard. However, the minimum working load shall be not less than 400Kg. The Winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers.

The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. The rope termination in the winch shall be such that distortion or twisting is eliminated and at least 5 to 6 runs of rope remain on the drum even when lantern carriage is fully lowered and rested on the rest pads.

It should be possible to operate the winch manually by a suitable handle and / or by an external power tool. It shall be possible to remove the double drum after dismantling, through the door opening provided at the base of mast. Also, a winch gear box for simultaneous and reversible operation of the double drum winch shall be provided as part of the contract.

7.10.5.5 **Head frame**

The head frame which is to be designed as a capping unit of the mast shall be of welded steel construction galvanized both internally and externally after assembly. (HOT DIP GALVANIZED).

The top pulley shall be appropriate diameter, large enough to accommodate the stainless-steel wire ropes and the multi-core electric cable& optical fiber cable for PTZ cameras. The pulley block shall be made of non-corrosive material, and shall be of die cast aluminum alloy (LM-6). Pulley made of synthetic material such as plastic or PVC are not acceptable. Self-lubricating bearings and stainless-steel shaft shall be provided to facilitate smooth and maintenance free operation for a long period. The pulley assembly shall be fully protected by a canopy galvanized externally and internally.

Close fittings guides and sleeves shall be provided to ensure that the ropes and cables do not dislodge from their respective positions in the grooves. The head frame shall be provided with guides and stops with PVC buffer for docking the lantern carriage.

7.10.5.6 **Stainless Steel Wire Ropes**

The suspension system shall be essentially being without intermediate joint and shall consist of any non-corrosive stainless steel of AISI 316 or better grade.

The stainless-steel wire ropes shall be of 7/19 construction, the central core being of the same material. The overall diameter of the rope shall not be less than 6 mm. The breaking load of each rope shall not be less than 2350kg individually, giving factor of safety or over 5 for system at full load, the minimum recommended value as per the TR-7 referred to in the beginning of the specification. The end construction of rope to winch drum shall be fitted with talurit.

The thimbles shall be secured on ropes by compression splices. Two continuous lengths of stainless-steel wire ropes shall be used in the system and no intermediate joints are acceptable in view of the required safety. No intermediate joints, either bolted or else is provided on the wire ropes between winch and lantern carriage.

Fig: Typical footing including base plate and anchor bolt

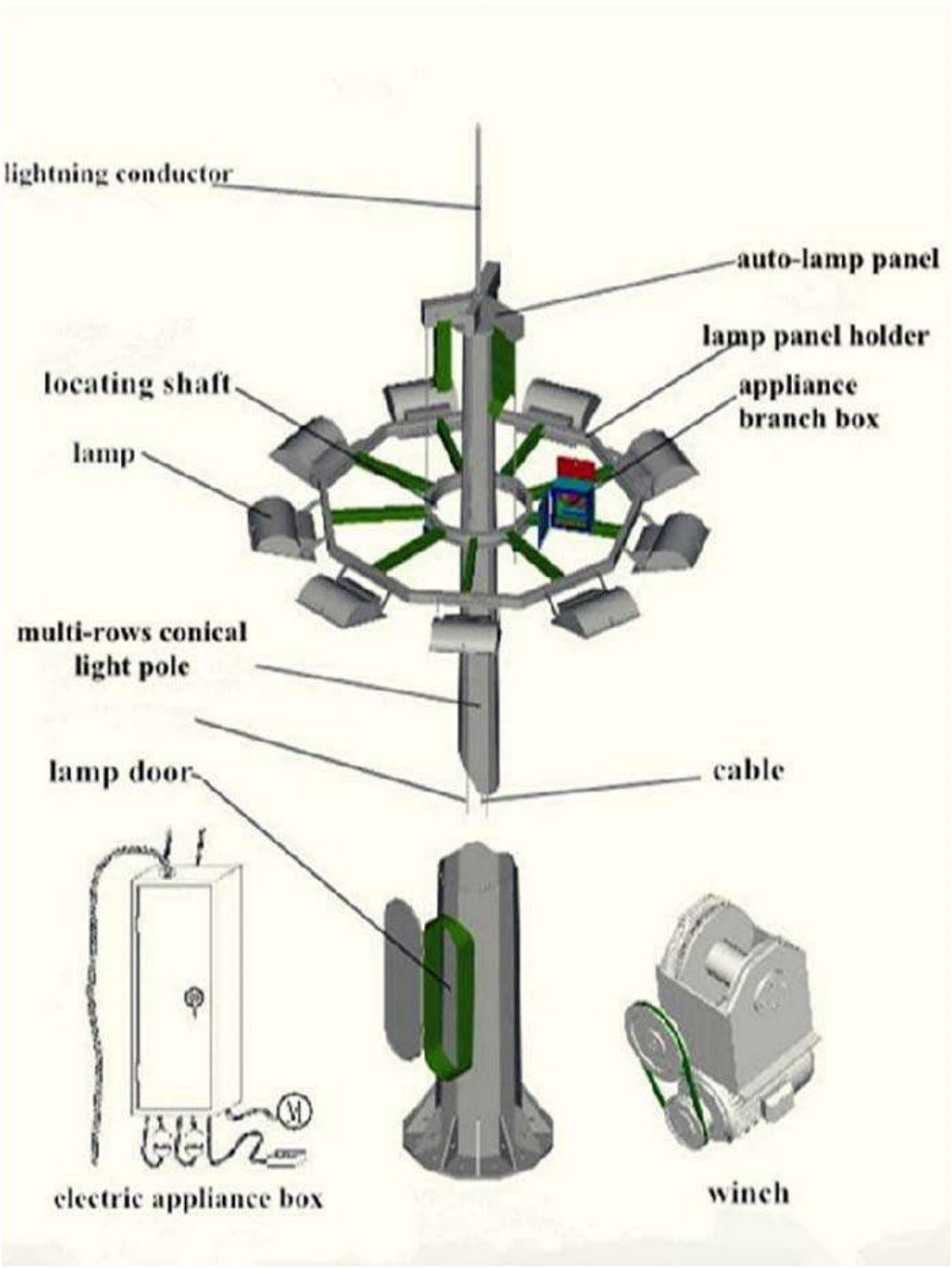


Fig: Typical features of High Mast pole

CHAPTER 8 LIGHTS, FANS AND FIXTURES

8.1 LED SPOT LIGHT

The light fitting shall be manufactured as per design, specification and schedule and shall comply with the relevant requirements of standards. Conceal type LED spot light fitting of the following features and model will be supplied with all necessary elements such as driver, chips etc. complete. Model and sample shall be approved by the Engineer/ PIT.: -

(i) Square panel (conceal type) ENERGY+ cat. no.- EPPLLED 2005 or equivalent product of GLORIA, SUNKO, ENERGYPAC etc.

(ii) Rated life: 30,000 hr. (minimum)

(iii) Luminous flux: 100 + 1m/w

(iv) LEDchips: EDISON / EPISTOR / OSRAM / PHILIPS / CREE /BRIDGELUX.

(v) Driver: MEANWELL / OSRAM / PHILIPS / IEC standard.

8.2 EXIT LIGHT

Emergency exit light is important during a period of fire hazard which will show a path of safe exit from floor. LED sign of the following features and model with all necessary elements such as drivers, chips etc. complete model and sample shall be approved by proper authority.

i. Battery Type: Ni-CD

ii. Material: Aluminium+Acrylic

iii. Light Source: LED

iv. Colour Temperature (CCT): 5000K (Daylight)

v. Input Voltage(V): AC 85-265V

vi. Lamp Luminous Efficiency(lm/w): 120

vii. Colour Rendering Index (Ra): 90

viii. Support Dimmer: NO

ix. Lifespan (hours): 50000

x. Working Time (hours); 50000

xi. Wattage: 6W

xii. IP Rate: IP30

xiii. Emergency Power: 4W

xiv. Battery: 3.6V 600mAH

xv. Emergency Time: More Than 180 mins

xvi. Operation Temperature: 0~50 degree Celsius

8.3 **LED TUBE & PANEL LIGHT FITTINGS**

Supply & fixing LED tube & panel light fittings of following specifications:

i. Luminous efficacy: 100 lm/W(minimum)

ii. Power Factor: minimum 0.95

iii. Color Rendering Index(Ra):For office and other types of buildings 70≤Ra<85

iv. Driver: MEANWELL/OSRAM / ENERGY+/ SIGNIFY(PHILIPS) or equivalent IEC standard,

v. LED chips:EPISTAR / OSRAM / SIGNIFY(PHILIPS) / CREE / BRIDGELUX or equivalent.

vi. Color temperature: 3500K-6500K (Warm-White)

vii. 2 years warranty

viii. Tube Light: 4' x 36 W, Aluminium Alloy ABS Plastic

ix. Square Panel Light: Aluminium Alloy Acrylic,

Size: 600 mm x 600 mm; 36 W

8.4 **LED TOP DOWN OUTDOOR LIGHT FITTINGS**

Supply & fixing 10Watt, LED top down light fittings of following specifications:

i. Luminous efficacy: 100 lm/W(minimum)

ii. Power & Power Factor: 10Watt & pf 0.95

iii. Color Rendering Index(Ra):For office and other types of buildings 70≤Ra<85

iv. Driver: MEANWELL/OSRAM / ENERGY+/ SIGNIFY(PHILIPS) or equivalent IEC standard,

v. LED chips:EPISTAR / OSRAM / SIGNIFY(PHILIPS) / CREE / BRIDGELUX or equivalent.

vi. Color temperature: 3500K-6500K (Warm-White)

Fig: LED top down outdoor light

8.5 CEILING FAN

8.5.1 Material:

Ceiling fan shall be of capacitor type, AC 240V single phase, 50Hz, complete withminimum 305 mm. (1 ft) long down rod, blades, capacitor canopy, etc. connecting PVC wire complete as required. regulator, suspension rod of required length, canopy and shall be constructed in accordance with applicable B.S. The minimum air velocity for 1400mm fan at horizontal distance of 600mm from the fan center and vertical distance of 1950mm shall be 47-meter minute. Appropriate sample of fan shall be submitted prior to installation for approval.

Rated voltage: 220 volts

Rated frequency: 50 Hz

Rated speed: 300 rpm ± 10 %

Service Value: Minimum 2.80 m3/ min/watt

Temperature Rise: Maximum 70ºC

Class of Insulation: Class-E

1422.4 mm. (56")

8.5.2 **Installation:**

The fans shall normally be installed at a height of 2550 mm from the floor and in accordance with the applicable fan layout drawings and direction of Engineer/ PIT. Circular box with ceiling rose for fan outlet shall be at the center of the clamps. Fan incorrectly located or any mal-function of any fan shall be rectified or replaced by the Bidder at their own expense.

8.6 EXHAUST FAN

Providing and fixing of 8" & 10" axial flow AC capacitor type wall mounted exhaust fan complete with blade, steel frame standard wall louver shutter, PVC insulated connecting wire etc. complete as required including cutting wall and mending good the damages as per direction of the Engineer.

8.7 DISTRIBUTION and SUB-DISTRIBUTION BOARD (DB AND SDB)

8.7.1 **Material**

The MDB/DB/SDB shall be as per design, specification and schedule and shall be of safety dead front fixed type, having circuit breaker. Panels shall be designed for operation on a 240/415V, 50Hz, 3 phase, 4 wire system. The panels and bus bars shall have clearly marked identification.

The panels shall be semi-textured powder spray finish with polyester compound, color RAL 7032-pebble gray or shall be epoxy polyester powder finish of gray Duco to BS 38 IC shade, or other approved color with standard concentric knockouts of required sizes all around.

The DB/SDB panel material shall be steel sheet or insulation materials of min 1.5mm thickness. The panels shall have printed directory on frames and on/inside of door. The door is to be provided with flush lock handle. All doors are to be keyed alike. All hinges shall be concealed. All bus bar shall be isolated by proper voltage rating insulators from board body, and front side of bus bar must have protective (insulation) cover. Provision for cable entry to the DB shall be from top, bottom and sides.

The MCB/MCCBs shall be quick-make, quick-break type, and shall have inverse time limit characteristics with instantaneous magnetic trip elements functioning on overload, earth fault and short circuit. All circuit breakers shall be 'trip free'. Ratings and frame sizes of breakers shall be in accordance with design and schedule. Each breaker shall be capable of carrying rated full load current continuously without exceeding temperature rise specified in the reference IEC standard. Circuit- breaker insulation shall be coordinated with the DB structure and shall be designed for use on 600-volt system. The MCB must comply with BS 3871: part I (1965) category M3 (5A-60A). Rated voltage 240/415V, A.C.50Hz, minimum interrupting capacity 5000 amp as per B.S. and capable of providing overload and short circuit protection, through thermal and magnetic trip actions respectively. Temperature rating, of CB shall be 400 C, preferably tropicalized (moisture fungus corrosion treated), with contacts of silver alloy. The MCCB must comply with BS 387 l; part 2 (1966).MCCB above 25A TP shall be adjustable type.

The MCCB's shall have the following minimum symmetrical interrupting capacity as per B.S. and IEC, at 415V A.C. if not indicated otherwise:

Upto 50 ATP : 15 kA

51 ATP to 100 ATP : 25 kA

101 ATP to 300 ATP : 35 kA

301 ATP to 800 ATP : 50 kA

801 ATP to above : 65 kA

MCB upto 63ATP or SP shall have 6 kA rating. SDC (Switch Disconnector) upto 125 ATP is 3 kA, upto 250 ATP is 4.3 kA.

The continuous current rating of individual MCB/MCCB's may be varied within+ 15% at the time of installation without any additional cost implication.

8.7.2 **Installation:**

The Board shall be installed in accordance with applicable layout drawing. Minimum height to bottom of the Board from the floor level shall be 600 mm and maximum height of any circuit breaker/switch shall be 1800 mm from the same level or as specified in the drawing. The minimum depth of MDB, DB or SDB shall be 250 mm. where there is kWH meter in the board and 200mm where there is no kWH meter.

The location of DB/SDB shown on design shall be considered as approximate and it shall be responsibility of the Bidder before installation of DB to study all pertinent drawings and obtain precise information from the architectural drawings. DB/SDB incorrectly located or any mal function of any equipment, instrument in any board shall be properly relocated or replaced by the Bidder at the Bidder's expense.

Number of outgoing circuits in different panel boards may be varied by+ 5% at the time of installation.

8.8 SWITCH SOCKET / FAN REGULATOR BOARD

8.8.1 Material:

Gang type Switch Socket board and fan regulator board shall be as per design, specification and schedule and shall have gang switches and fan regulators. The switches shall be vertical, single pole (1-way/2-way) 5A. A.C, white or approved color, to BS 3676:1963, complying with the test requirements for inductive, fluorescent or resistive loads as specified, and satisfy the test requirements of LED lamp circuits, upto the ratings of these switches, as set out in BS 3676 amendment 3:1969. The switches must have minimum clearance of 3mm between the contacts, and a similar creepage distance. All contacts shall be faced with pure silver/silver-cadmium oxide alloy. The switch operating member shall make the speed of 'make and break' independent of the speed at which the switch is operated. Sample shall be submitted for approval prior to installation of switches.

Each board shall have an earthing block of copper brass (38x10x10) mm with 5x5mm drilled holes and 5x3mm machine screw tapped hole.

8.8.2 Installation:

The switch board and fan regulator board shall be installed on wall at a height of 1.5 meter, if not specified otherwise, from the floor and at locations shown in applicable layout drawings. The fan regulators shall be installed inside the box with regulator knobs projected over the covering, if not specified otherwise. The phase wire shall be connected to the switches and the neutral wire shall be kept solid in all switch connections. The ECC shall be connected to the earth point inside the switch boards. Approved size steel boxes shall be installed at the time of construction of the wall to avoid chasing in wall.

The location of board shown on design shall be considered as approximate and it shall be responsibility of the Bidder, before installation switch board/regulator board boxes, to study all pertinent drawings and obtain precise information from the Architectural drawings and approved shop drawings of other trades. Switch boards/regulator boards incorrectly located shall be properly relocated at the Bidder's expenses.

8.9 SOCKET/MCB OUTLET

8.9.1 Material

Socket outlets shall be white in color, and confirming to B.S.546: 1950 (3 pins) and B.S. 372: part 1:1930 (2 pins). All switched sockets shall have pure silver/silver-cadmium oxide alloy contacts in which contact pressure shall be permanently maintained by subsidiary helical compression spring. These shall be supplied with countersunk cadmium plated fixing screws and mounted in 18 SWG (1.5 mm) hammer painted sheet steel box having brass earth point as per drawing and direction. All switch and socket outlets shall be international standard type and shall be of same manufacturer. The country of origin of switches and sockets shall be USA, UK, Germany, French or Japan.

The Controlled sockets of MCB/MCCB, if applicable, shall be unswitched and the box shall have earth point.

8.9.2 Installation

The Socket/MCB/MCCB shall be installed on wall with lower end of the face plate at a height of 225mm (Skirt level) from the floor, if not specified otherwise, and locations shown in applicable design.

The fixing of the outlet’s boxes shall be by means of flat head cadmium plated screws. The flat head of the screw shall be sunk in the plates so as to finish flush with the surface of the cover. The mounting height of the outlet shall be as shown in the drawing. The earth wire shall be connected to earth point of the box to the 3rd pole of the 3-pin socket.

BANGLADESH NAVY

ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

TECHNICAL SPECIFICATIONS

FOR

AUXILIARY ITEMS FOR ADMINISTRATIVE WORKS

Document Code: CW-05

Prepared by

Bureau of Research, Testing and Consultation (BRTC)
Bangladesh University of Engineering and Technology (BUET)
Dhaka 1000, Bangladesh

April 2025

Table of Contents

CHAPTER 1 WINCH CONTROL FACILITY

1.1 FURNITURE

1.1.1 Tables

Item no.	Description	Quantity (Nos.)
1.	Table for Officer equivalent, size: 1.8m×1.7m×0.76m, Lacquer finish, with 1 side file cabinet & separated computer table. Model/Specs: HATIL Executive Table Milton-134-LAQUE or equivalent	01
2.	Secretariat table with 1 side file cabinet and 1 side integrated computer table for laboratory, R&D office, QC section office, dock office, and yard service office, etc. Size (mm): 1500×1200×750mm (min.) Weight: 80.0 kgs min. Preferred Brand: HATIL/OTOBI/REGAL/NAVANA/AKHTAR/PARTEX/BROTHERS (or equivalent).	03

1.1.2 Chairs

Item no.	Description	Quantity (Nos.)
1.	Chair for Officer equivalent, Revolving Arm Chair Model/Specs: HATIL Swivel Chair Umberto-121/ Swivel Chair Glister-130 or equivalent.	04
2.	Visitor chair for officer equivalent, Arm chair Model/Specs: HATIL Fixed Chair Priestly-104/ Fixed Chair Vinci-103 or equivalent.	10

1.1.3 Cabinet

Item no.	Description	Quantity (Nos.)
1.	Office rooms: All office rooms will have wall cabinet for file storing and printer tables. Model/Specs: HATIL Office Almirah Savanah-111 or equivalent. Printer Table: HATIL Side Rack Daphne-123-MFC or equivalent.	03
2.	Storage facility (Steel Almirah) Model/Specs: HATIL Office Almirah Mojave-103 or equivalent	03

1.1.4 Curtain

Item no.	Description	Quantity (Nos.)
1.	Windows will have venetian blinds (only officer's office).	As required
2.	Normal curtain (light) for others. All curtain shall hang down to floor skirting level unless specified otherwise by the client.	As required

1.2 OFFICE EQUIPMENT

1.2.1 Computers and Accessories

Item no.	Description	Quantity (Nos.)
1.	**Desktop computer:** Minimum Spec: Intel Core i7 13thGen. Processor [16 core, 28 threads, 30 MB Intel® Smart Cache]; Liquid CPU Cooler; 23.5" min. Full HD LED LCD IPS color monitor; 16GB DDR5 RAM (DDR5), 1.0TB M.2 nVME SSD Drive, Intel UHD Graphics 770 built-in motherboard, HDMI/VGA ports, wi-fi, Gigabit LAN, Audio in/out ports, USB 3.0 ports [min. 4 nos. on the back and two nos. on the front], USB Type-C ports; keyboard, mouse, webcam (720p Resolution), headphone with mic, Casing with two built-in casing fans and with 400W min. power supply unit, 1000VA UPS.	03
2.	Laptop computer Specs: Intel Core i7 13thGen. processor, min. 14.0-inchLED LCD FHD (1920 x 1080) display, 16 GB DDR5 RAM, 1.0TBNVMe M.2 HDD, built-in UHD graphics, Li-ion battery with min. 4:00 hr. backup with 220v power supply adapter, 5.1 audio,wi-fi, bluetooth, USB 3.0, USB type-C, HDMI in/out, built-in webcam, built-in mic, speaker, backlit keyboard, 1 yr. full warranty.	02
3.	A4 Laser printer black and white (Brand/model: HP Pro M404dn or Canon imageCLASS LBP214dw or equivalent.)	01
4.	A4 Laser printer color (Brand/model: HP Pro M454dw or equivalent.)	01
5.	Color multifunction device (600dpi A3 full-duplex color laser printer, print speed min. 30PPM in simplex mode, A3 double sided color scanning and photocopying using RADF at 600dpi optical resolution, A3 flatbed scanning and copying at 600dpi optical resolution, with built-in 200GB storage, LAN, WiFi and USB connectivity, LCD touchscreen control panel, two500-sheet paper trays, bypass paper feeder, configurable from computer over network, Brand/Model: Toshiba e-Studio 3015AC or equivalent)	01

1.2.2 Audio & Video

Item no.	Description	Quantity (Nos.)
1.	75” 4K LED Smart TV Brand/model: Sony BRAVIA KD 75X8000H 75 Inch 4K Ultra HDR LED Smart TV or equivalent.	01

CHAPTER 2 SECURITY MONITORING SYSTEM, PUMP & BLASTING SYSTEM, GENERATOR, ELECTRO-MECHANICAL & FIRE PUMP SYSTEM

2.1 FURNITURE

2.1.1 Tables

Item no.	Description	Quantity (Nos.)
1.	Table for Quarter Master and others, size: 1.8m×1.7m×0.76m, with 1 side file cabinet & separated computer table Model/Specs: HATILExecutive Table String-116/ Executive Table James-109 or equivalent.	04
2.	Tea table, Standard Model/Specs: HATIL Lute-104/ Sparse-101/ Cafeteria Morn-108- 2-77 or equivalent.	02
3.	Corner table, Standard	02

2.1.2 Chair

Item no.	Description	Quantity (Nos.)
1.	Chair for Quarter Master and Others, Revolving Arm Chair Model/Specs: HATILSwivel Chair Umberto-121/ Swivel Chair Glister-130 or equivalent.	02
2.	Chair for Guardroom, Swivel Chair without arm rest Model/Specs: HATIL or equivalent.	08

2.1.3 Cabinet:

Item no.	Description	Quantity (Nos.)
1.	Cabinet for Security Monitoring System, and Pump & Blasting System Model/Specs: HATIL Canary 104/ Bantam 103 or equivalent.	04
2.	Storage facility (Steel Almirah) Model/Specs: HATIL Office Almirah Colorado-102 or equivalent	08
3.	Printer Table: HATIL Side Rack Daphne-123-MFC or equivalent.	02
4.	Computer table: HATIL Dexter 104 or equivalent	02

2.1.4 **Curtain:**

Item no.	Description	Quantity (Nos.)
1.	Windows will have venetian blinds (only officer's office)	As required
2.	Normal curtain (light) for others	As required

2.2 **EQUIPMENT:**

2.2.1 **Computer & Accessories:**

Item no.	Description	Quantity (Nos.)
1.	Desktop computer with latest configuration (Spec: same as Sec. 1.2.1 item no.1)	02
2.	Black and White Duplex Laser Printer; A4, Legal size paper capacity, 250 sheet paper tray, WiFi connectivity etc. (Brand/model: HP Pro M404dn or Canon image CLASS LBP214dw or equivalent.)	01

Enclosure:

1. Drawings of ‘Ship Docking and Repair Facility’.

Member Secy	DNS (Rep) Member	DNP (Rep) Member
DNIT Member	DNAI&S Member	DNE Member
	DNW&EE President	

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF

SHIP DOCKING AND REPAIR FACILITY

AT MONGLA

DRAWINGS

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

TOPOGRAPHIC & CONTOUR SURVEY DRAWINGS

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS

N

SITE POSITION

LAT=22° 31' 27.20"
LONG=89° 35' 6.46"

BM & TBM DESCRIPTION

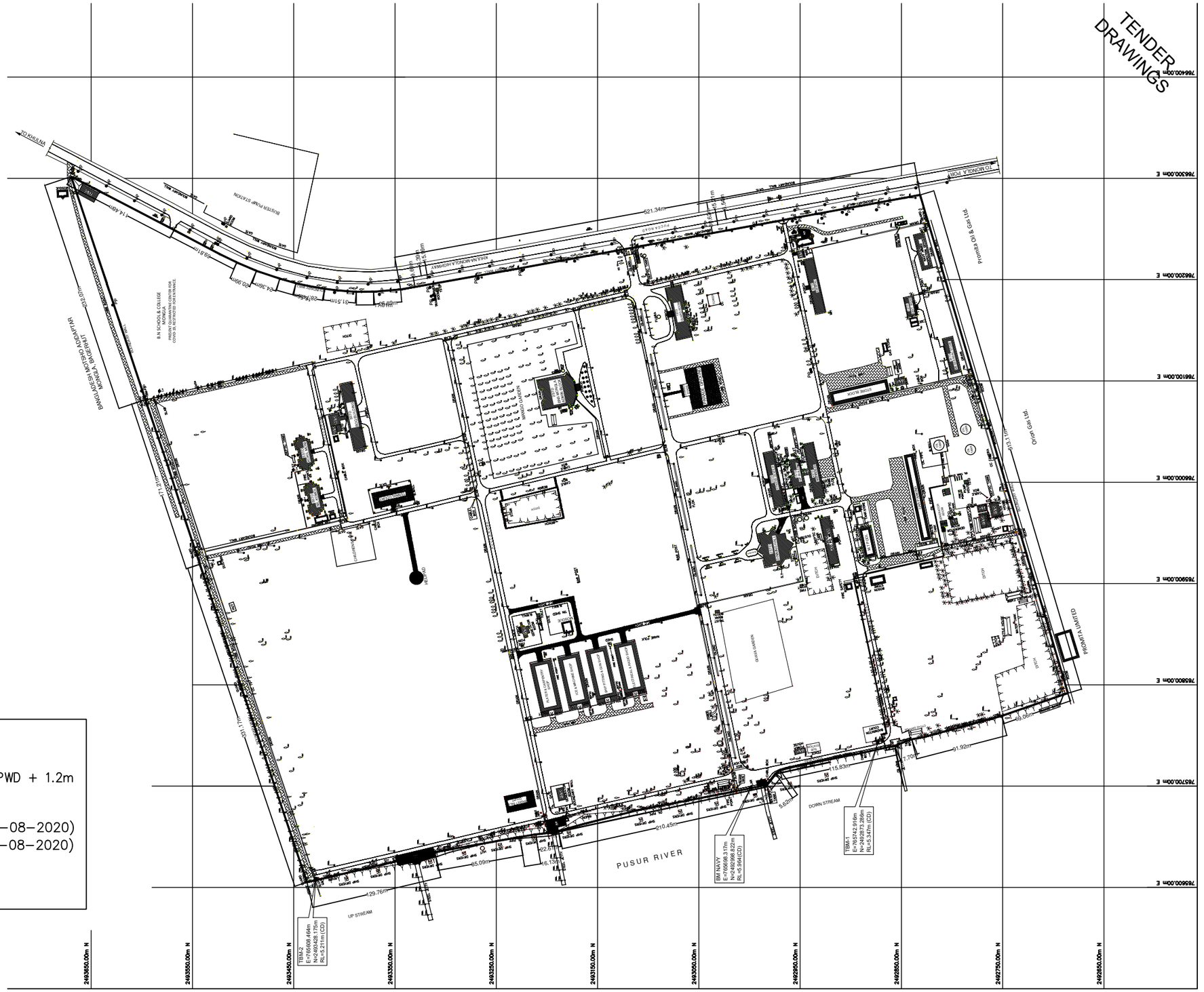
1. BM NAVY RL=5.964(CD)
   The Rcc pillar is situated near Nevel berths 3&4 as shown in the map.
2. TBM NO.1 RL=5.347(CD)
   Marked on the yelow paint , S/W corner of Oil manhole west side of badminton court as shown in the map.
2. TBM NO.2 RL=5.211(CD)
   Marked on the yelow paint , S/E corner of sluice gate, N/W corner of project boundary limit as shown in the map.

LEGEND:

1) Structure, Building, Semi pucca, Tin shed, Hut... ... ...
2) Road. Pavement, Earthen Road, Brick paved, Footpath. ... ...
3) Khal, Tank, Ditch, Cutting, Embankment, Well.... ... ...
4) Wall, Boundarylimit, Wirefencing, Railway line... ... ...
5) Powerpole (PP), Light post (LP), Telephone (TP).... ... ...
6) Tree: Nim, Jam, Litchi, Ucaliptus, Orjun, Banana, Shishu, Krishnocura, Amloki, Mehuguni, Mango, Jackfruit, Koral, Coconut, Date tree, Nut, Plam, Flower, Bamboo, Others...
7) Bench Mark (B.M), Spot Level, Mosque, Contour. ... ... TBM 1.201

Note:

1. All dimensions are in meter.
2. All Heights are in meter NAVY (CD) datum. Use CD = PWD + 1.2m
3. Contour interval 0.50 Meter.
4. All coordinate are in Meter WGS84 UTM datum.
5. Low tide Level = 1.673 (Time: 11.45am on dated 24–08–2020)
6. High tide Level = 4.503 (Time: 4.15pm on dated 24–08–2020)
7. H.F.L RL=5.672m (in 1988 from local information)
8. Property area = 443887 sq.m. (approx.)



PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SITE SURVEY DRAWING SHEET TITLE: TOPOGRAPHIC LAYOUT DRAWING Surveyed by: Mr. Masud Rana SCALE:

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:
Drg No. D-02-A-001		

TENDER DRAWINGS

SITE POSITION

LAT=22° 31' 27.20"
LONG=89° 35' 6.46"

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LEGEND:

1) Structure, Building, Semi pucca, Tin shed, Hut... ... ...
2) Road. Pavement, Earthen Road, Brick paved, Footpath. ... ...
3) Khal, Tank, Ditch, Cutting, Embankment, Well..... ... ...
4) Wall, Boundaryimit, Wirefencing, Railway line... ... ...
5) Powerpole (PP), Light post (LP), Telephone (TP) ... ...
6) Tree: Nim, Jam, Lichi, Ucaliptus, Orjun, Banana, Shishu, Krishnocura, Amloki, Mehuguni, Mango, Jackfruit, Koral, Coconut, Date tree, Nut, Plam, Flower, Bamboo, Others...
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Note:

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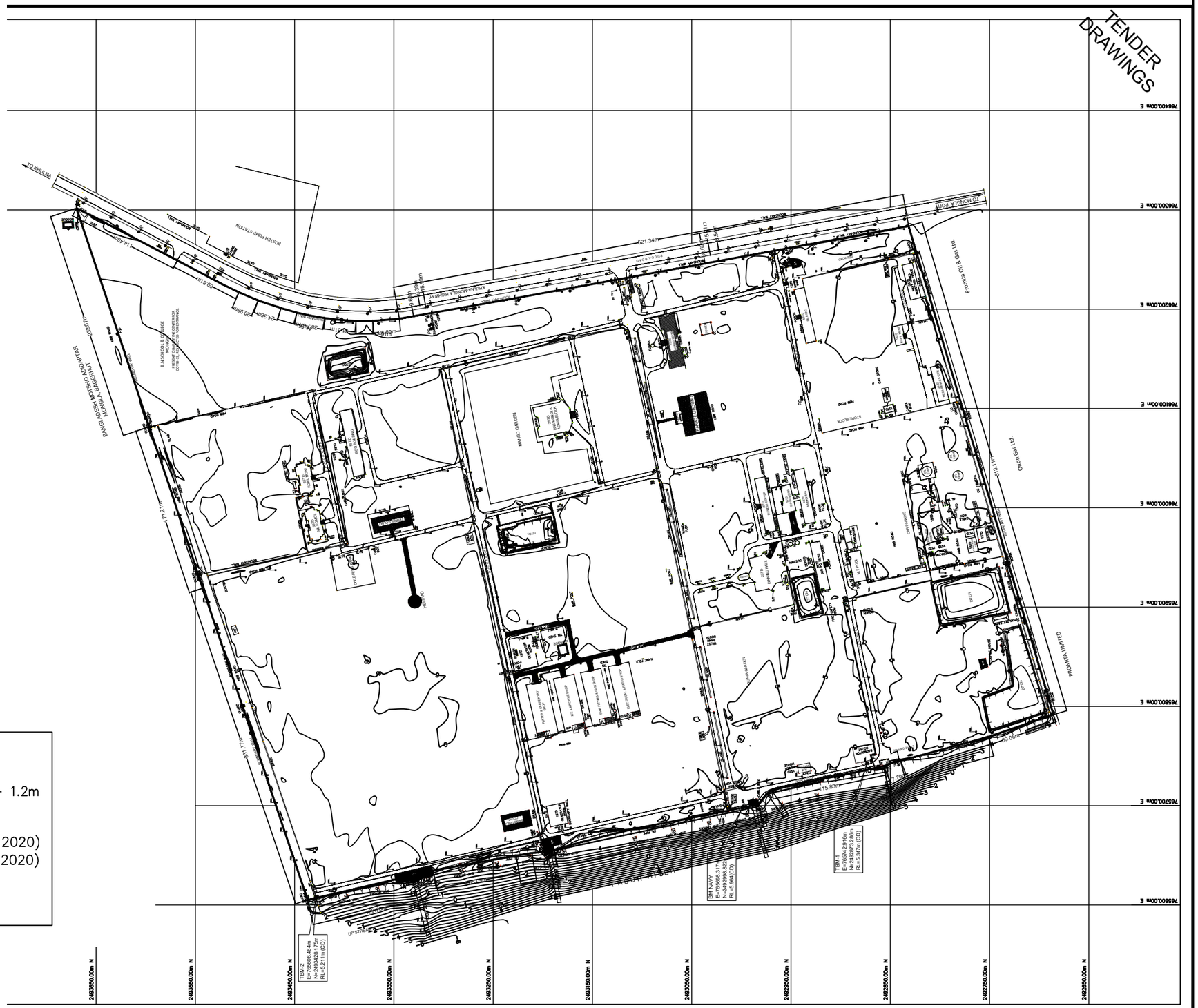


PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SITE SURVEY DRAWING SHEET TITLE: CONTOUR LEVEL DRAWING Surveyed by: Mr. Masud Rana SCALE:

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:
Drg No. D-02-A-002		

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

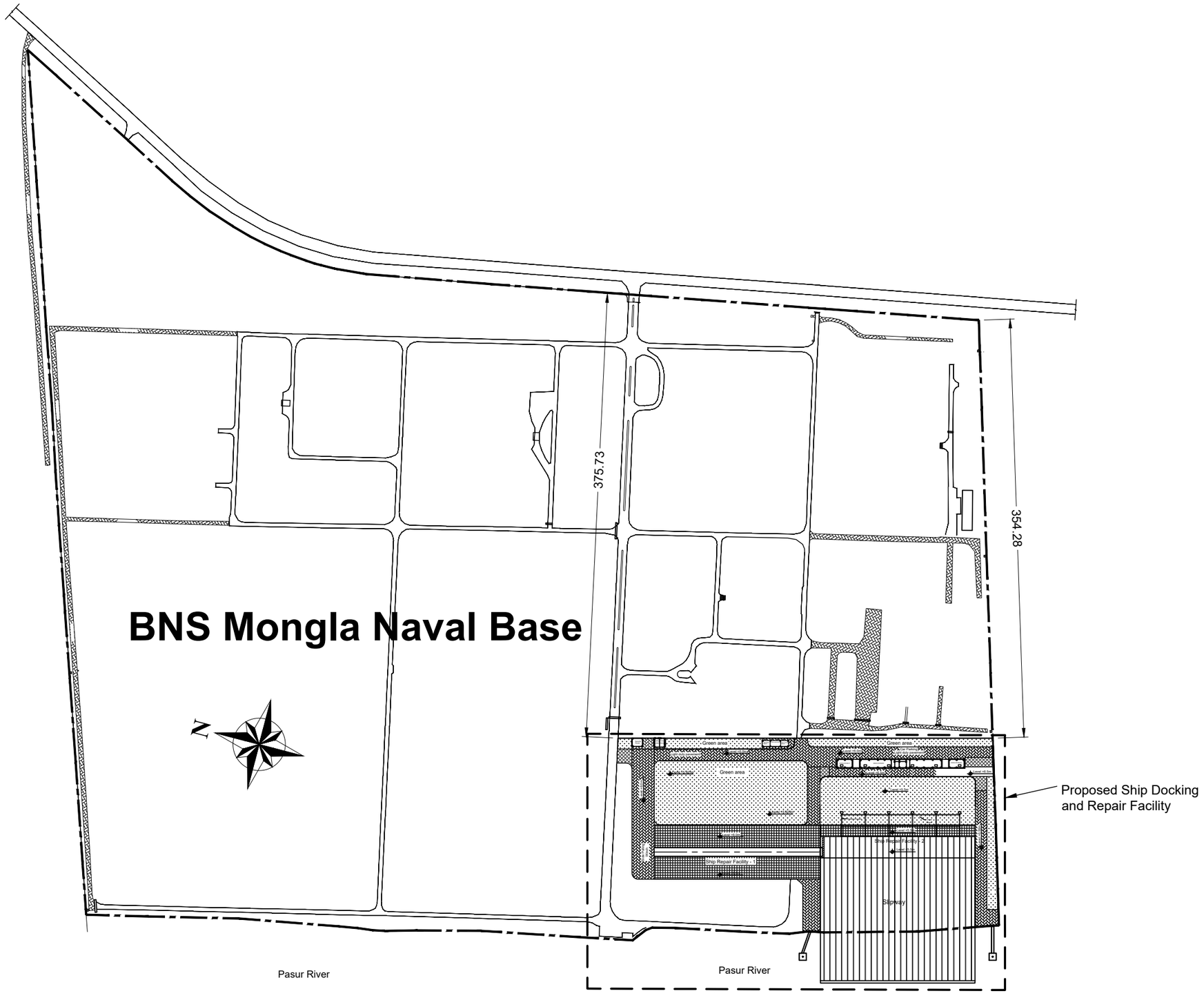
GENERAL LAYOUT OF SHIP DOCKING AND REPAIR FACILITY

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: GENERAL LAYOUT	Revision History:	
			SHEET TITLE: Site Location at BNS Mongla	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
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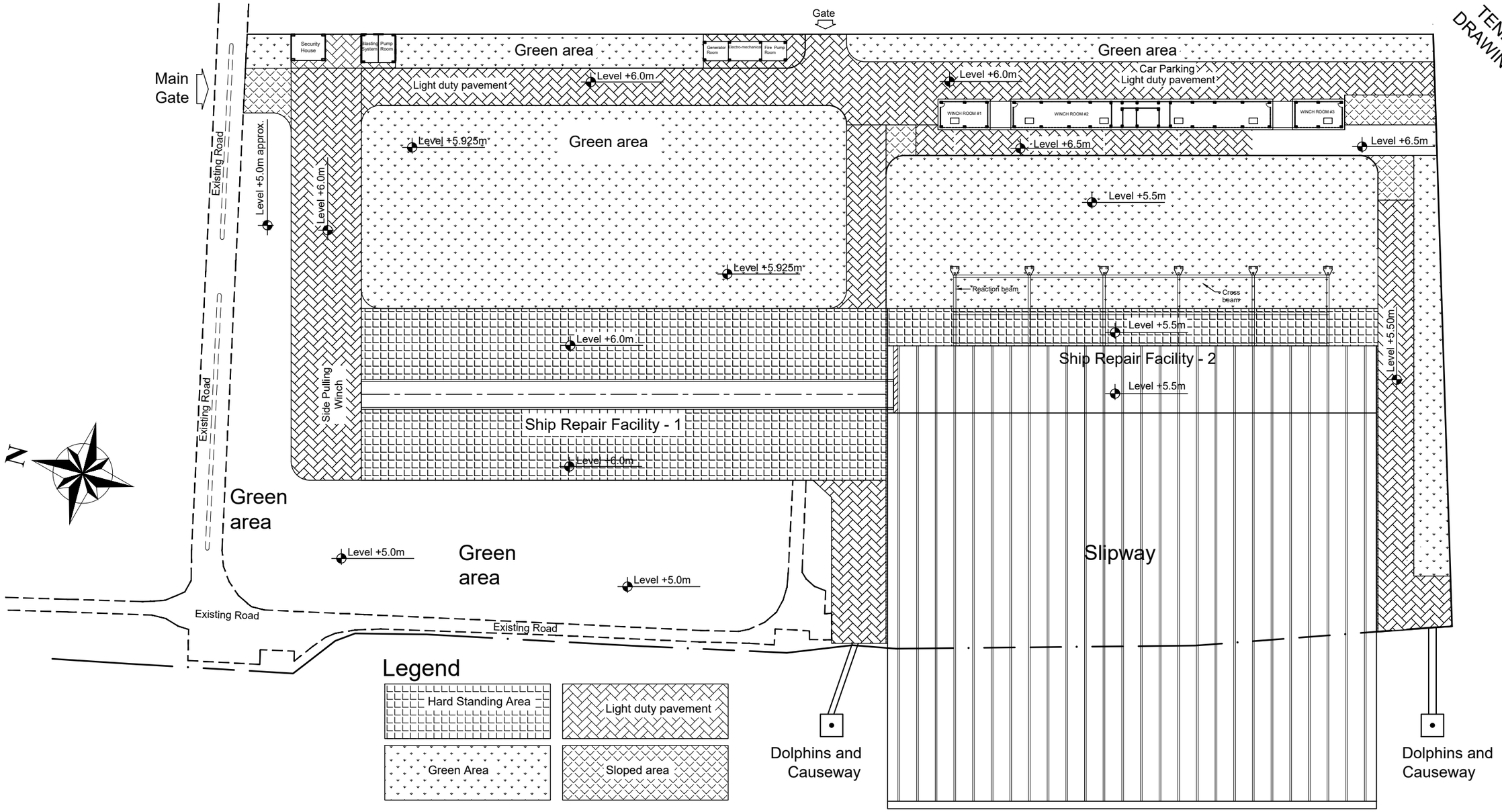
TENDER DRAWINGS

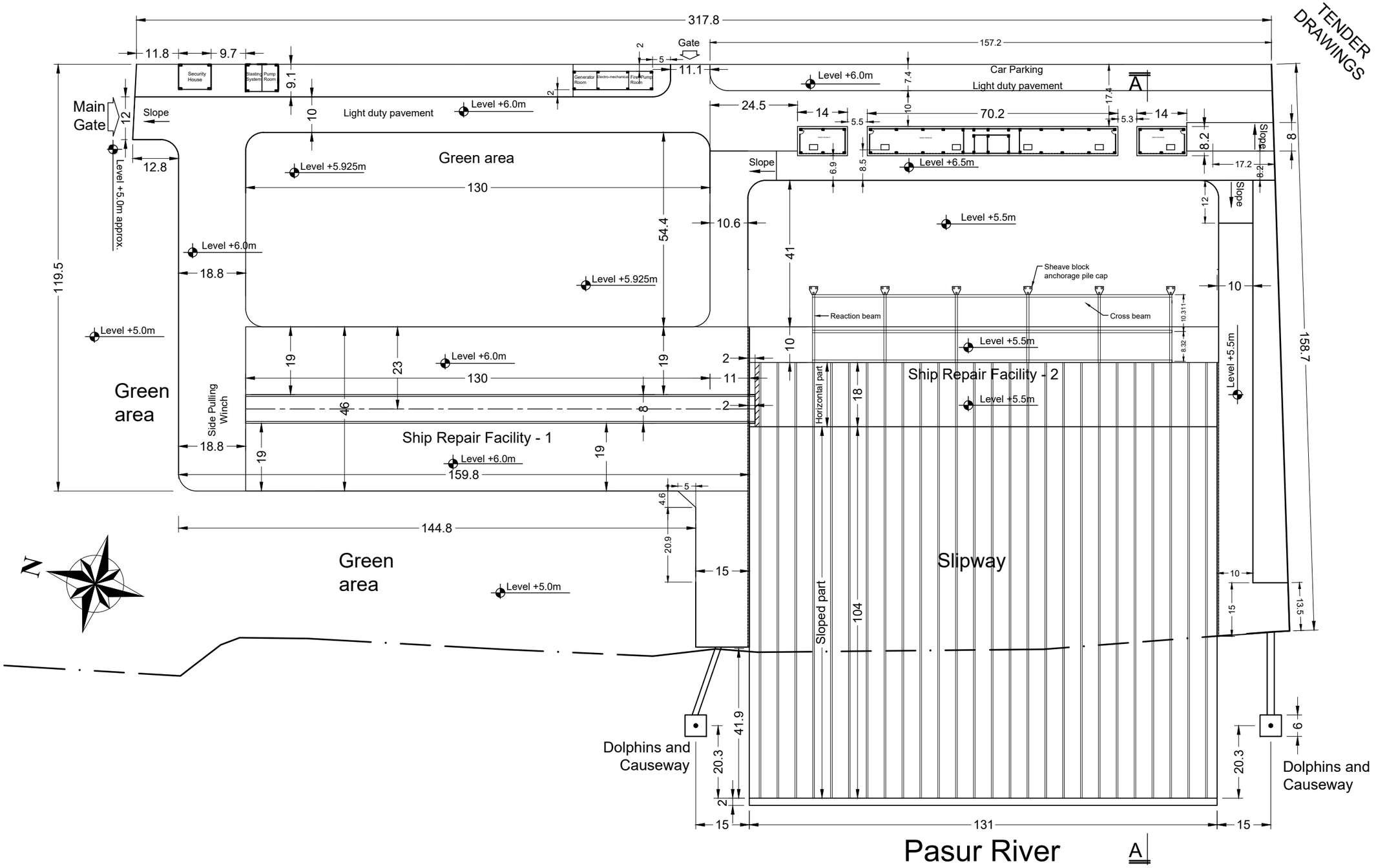


Notes:

a. All dimensions are in meter unless otherwise shown.
b. All levels are in Chart Datum
c. Levels shown are of general nature. Actual precise levels may vary a little due to cross slope provided for drainage in open areas.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: GENERAL LAYOUT SHEET TITLE: General Site Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-03-A-002
				Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



Note:

a. All dimensions are in meter unless otherwise shown.
b. All levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: GENERAL LAYOUT		Revision History:
			SHEET TITLE: Site Layout Plan Details		1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
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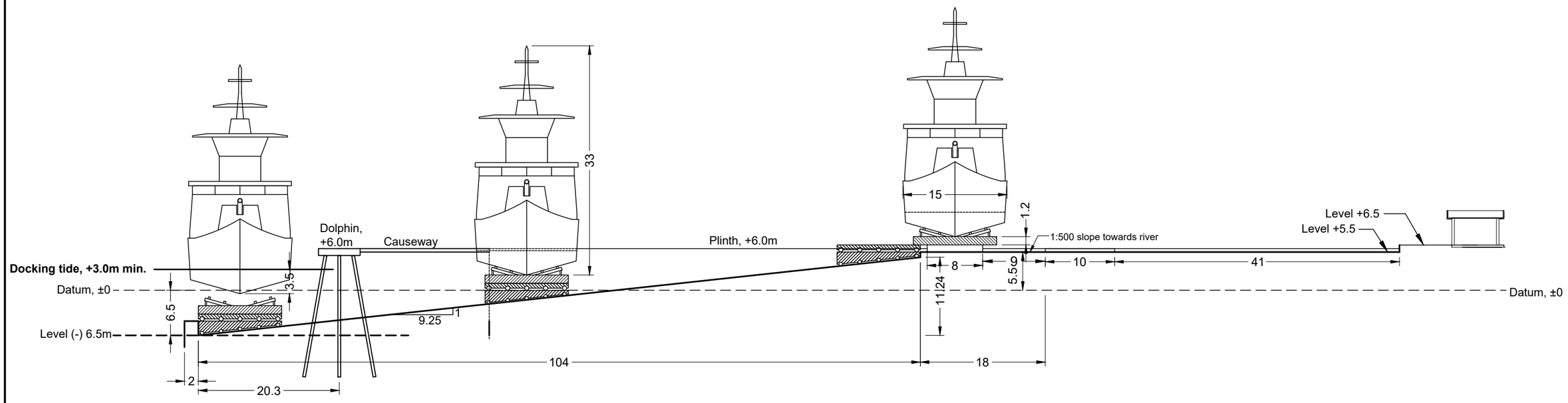
TENDER DRAWINGS



Section A - A

Note:

a. All dimensions are in meter unless otherwise shown.
b. All levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: GENERAL LAYOUT	Revision History:	
			SHEET TITLE: Sectional North Elevation of the Slipway	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-03-A-004	

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

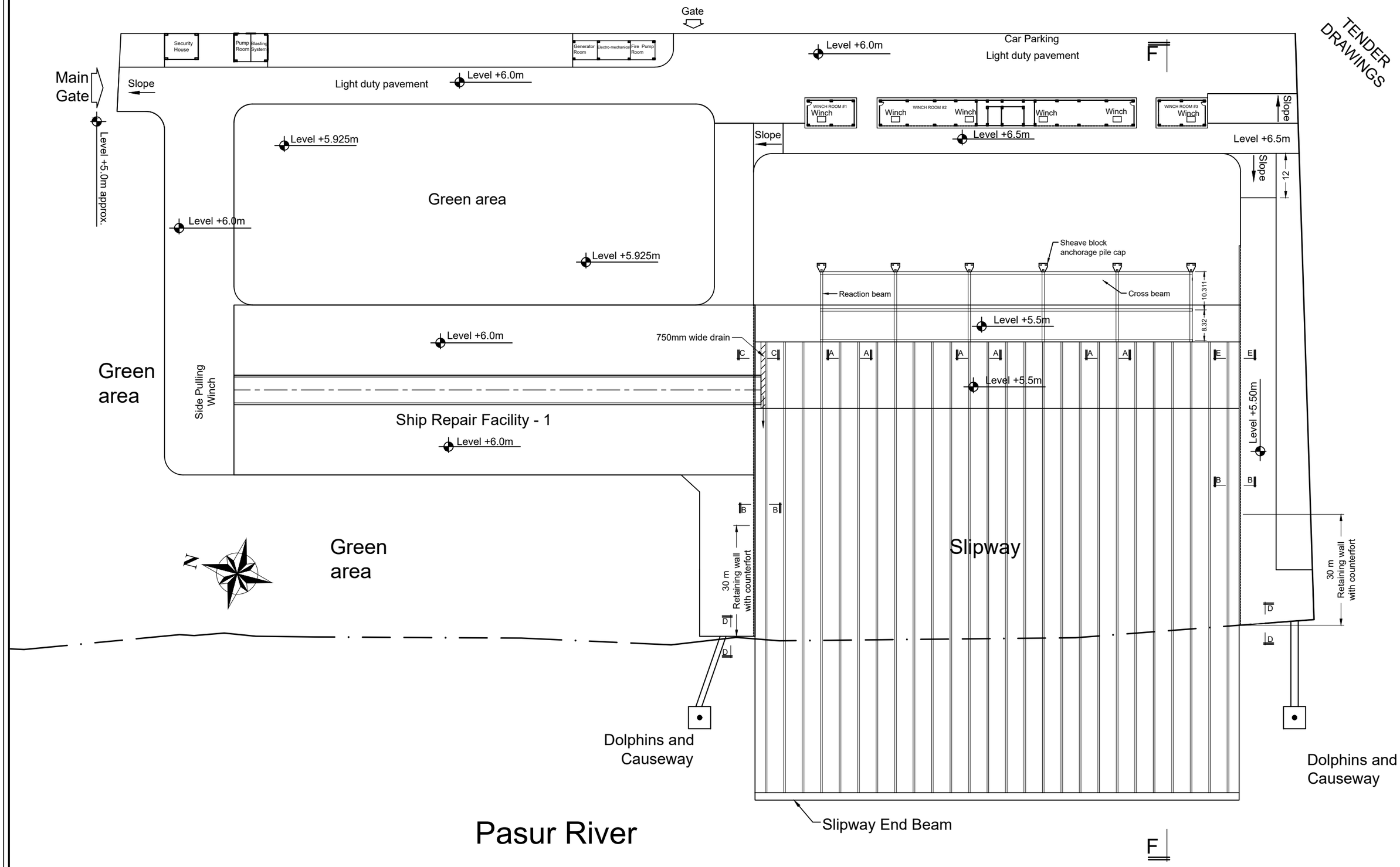
SLIPWAY & CRADLE DESIGN

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

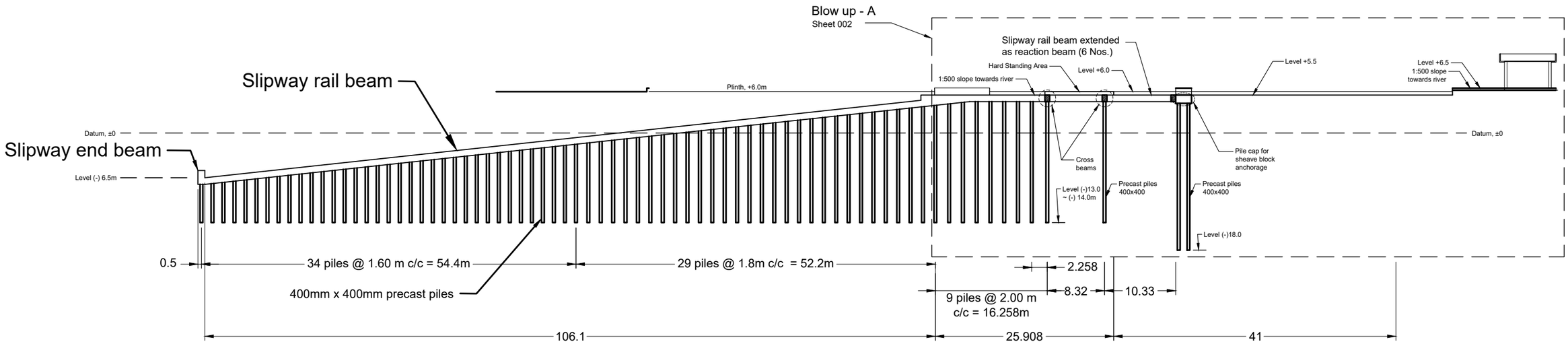
April 2025

TENDER DRAWINGS



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Slipway Layout Plan CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-001	Date: 30-Apr-2025 Status: Revision: R-00

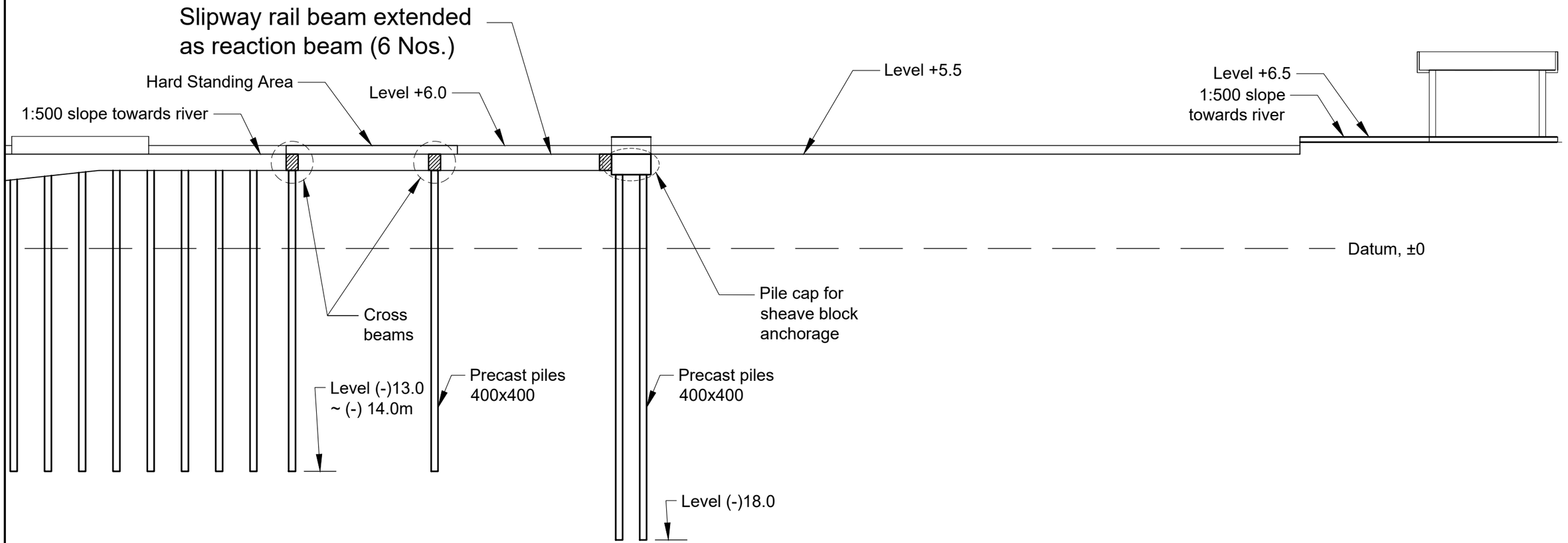
TENDER DRAWINGS



TYPICAL LONG SECTION OF SLIPWAY
Section F-F

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN	Revision History:	
			SHEET TITLE: Typical Long Section of Slipway	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-04-A-002	

TENDER DRAWINGS



Blow up - A

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN		Revision History:
			SHEET TITLE: Typical Long Section of Slipway	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-04-A-003

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

TENDER DRAWINGS

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M≥0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

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			SHEET TITLE: General Notes for RC Construction: 1 of 2	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-04-A-004

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

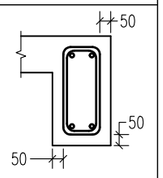
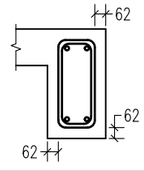
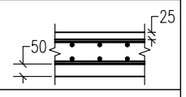
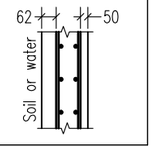
6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

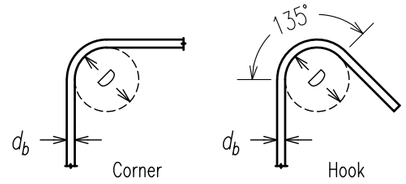
7. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Beam on ground	Top, side & bottom	50mm	
	In contact with soil or water	62mm	
Slab on ground	Top and bottom	25mm and 50mm	
R.C.C wall below ground	In contact with soil or water	62mm	
	Other	50mm	

8. BAR BENDING PIN DIAMETER FOR HOOKS AND L–BENDS

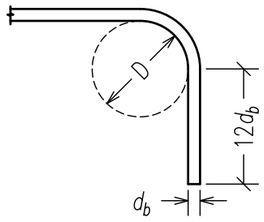
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement



D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

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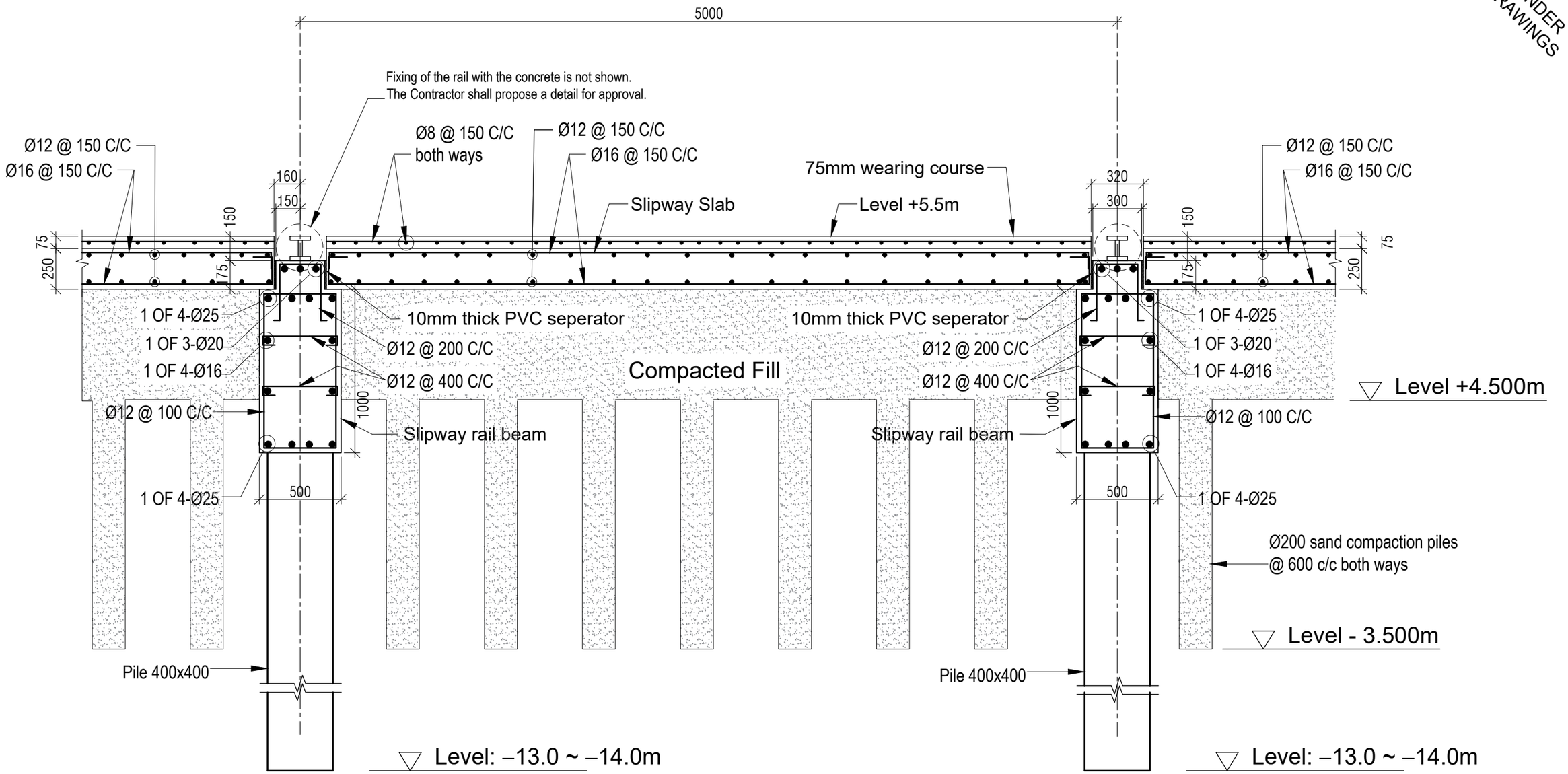
			SHEET TITLE: General Notes for RC Construction: 2 of 2	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-04-A-005

TENDER DRAWINGS

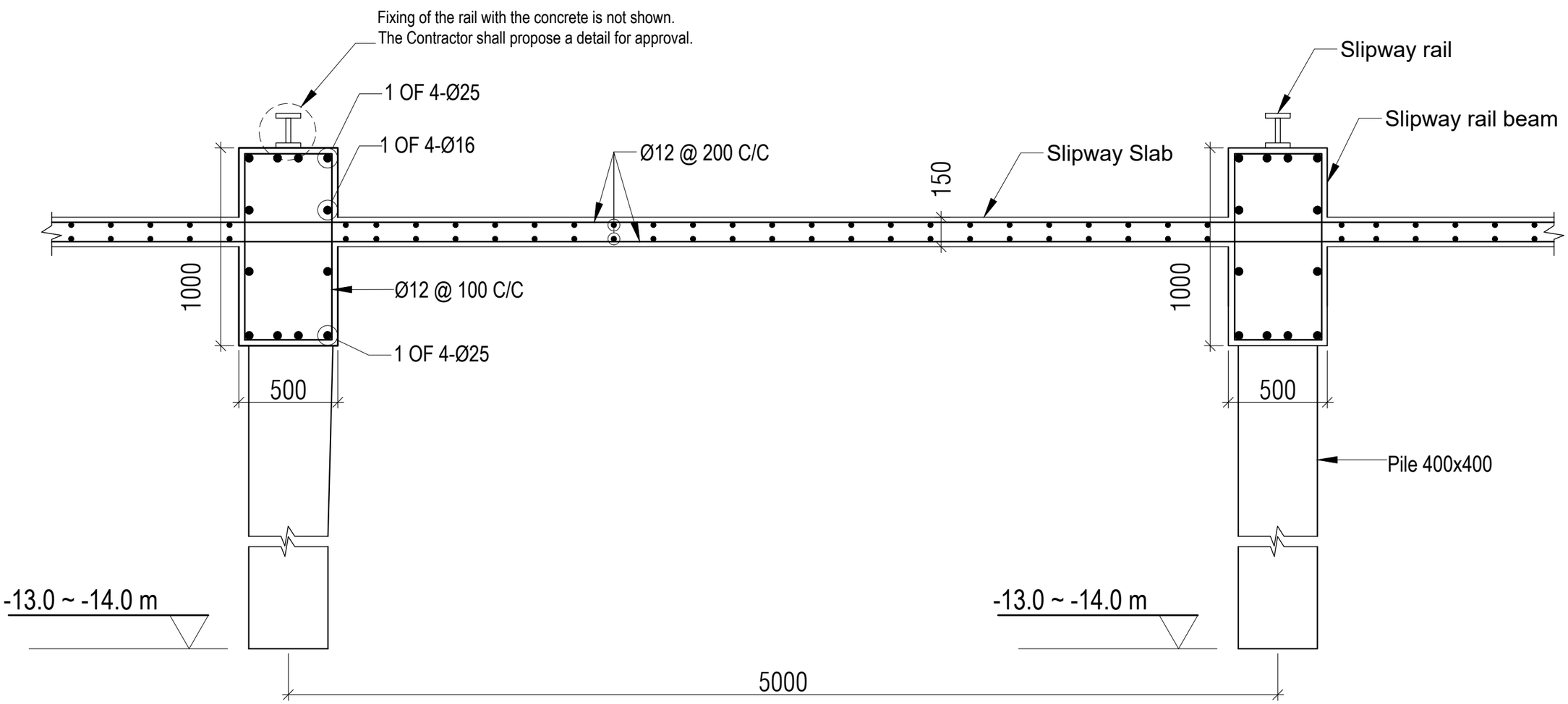


TYPICAL SECTION A-A

TYPICAL TRANSVERSE SECTION OF SLIPWAY ON HORIZONTAL PART

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN	Revision History:	
			SHEET TITLE: TYPICAL TRANSVERSE SECTION OF SLIPWAY AT HORIZONTAL PART (Level +5.50m)	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-04-A-006	

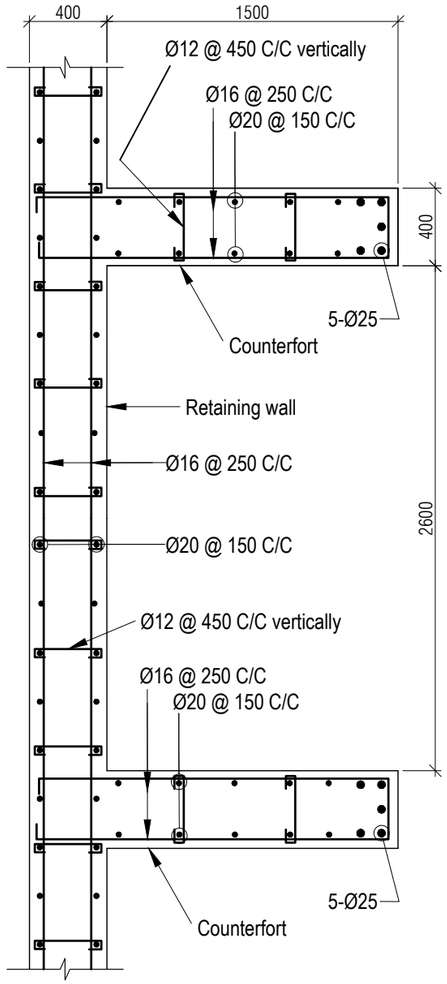
TENDER DRAWINGS



TYPICAL TRANSVERSE SECTION OF SLIPWAY ON INCLINED PART

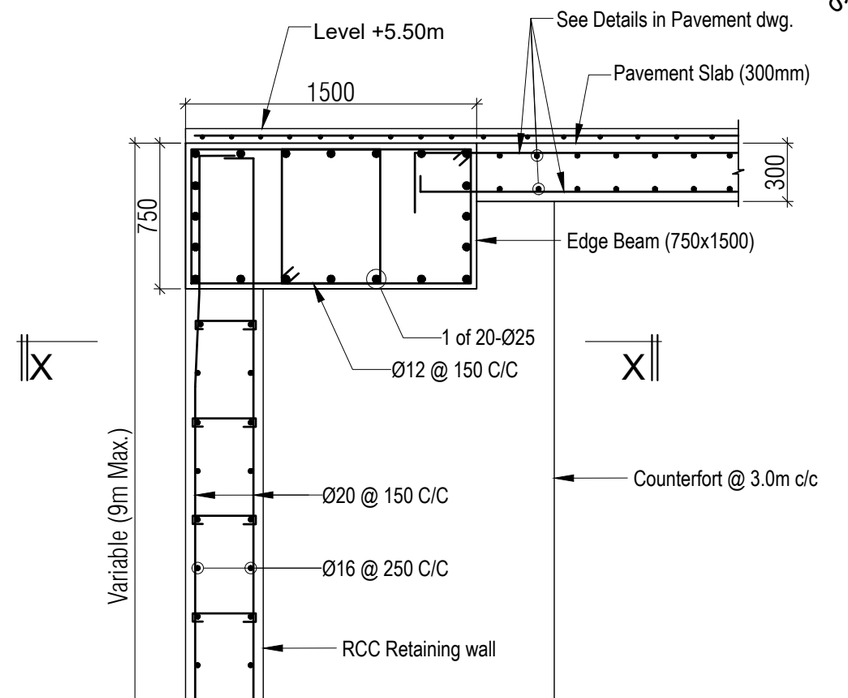
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN	Revision History:	
			SHEET TITLE: TYPICAL TRANSVERSE SECTION OF SLIPWAY ON SLOPED PART	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-04-A-007	

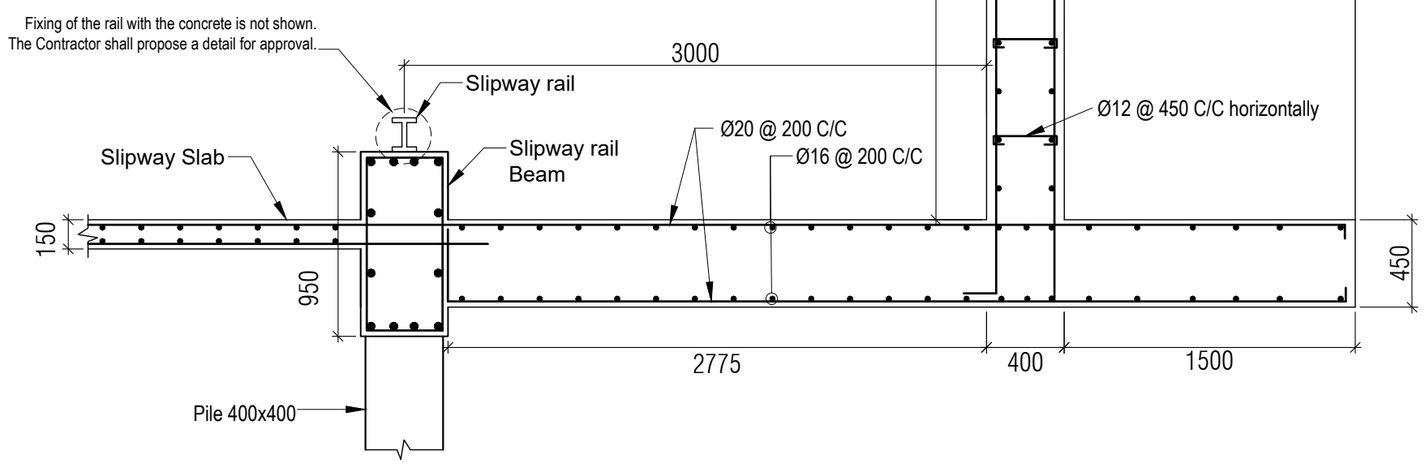
TENDER DRAWINGS



SECTION ON X-X (Plan View)

Note: Counterforts shall be required for 30m portion of the retaining wall from the shore line

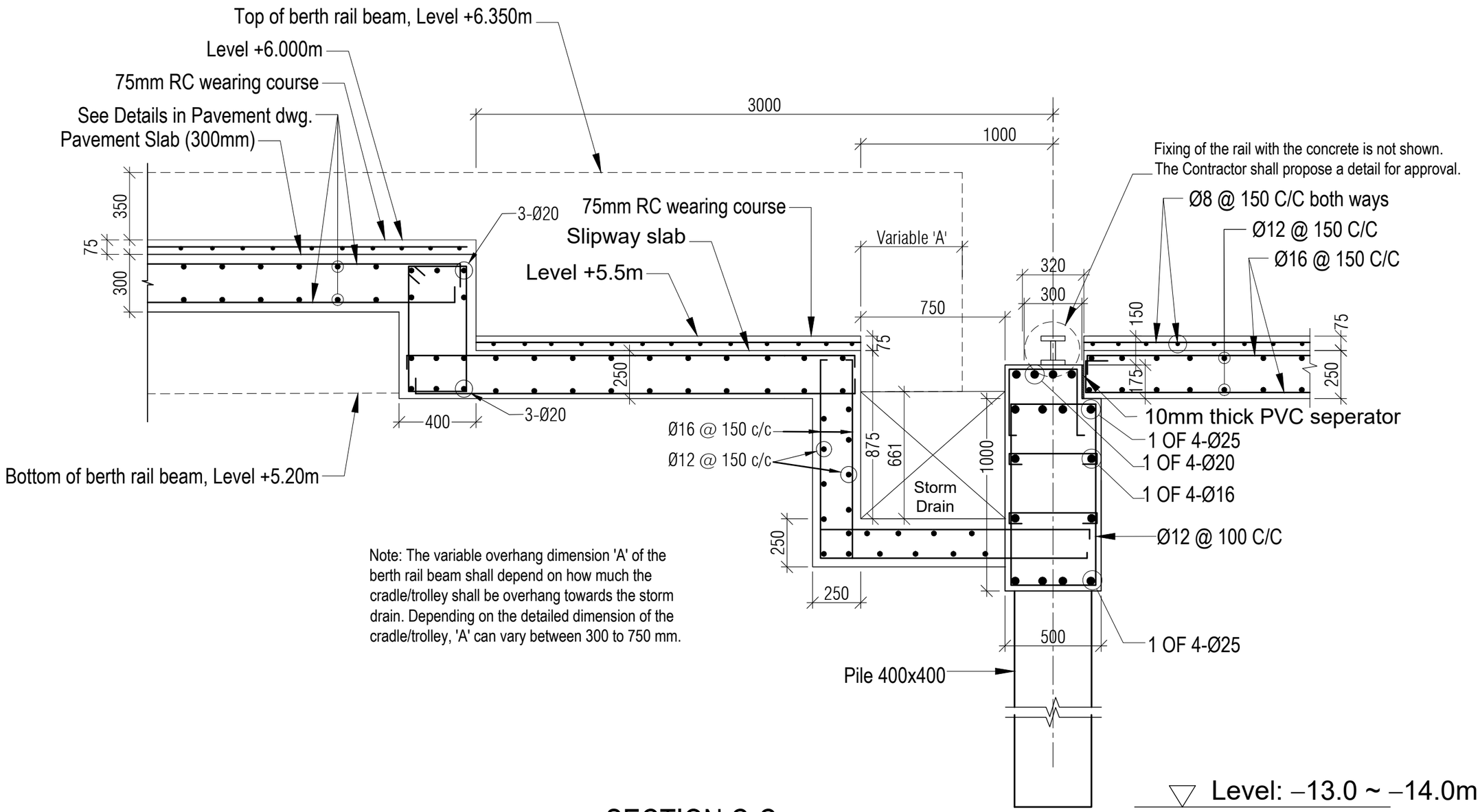




SECTION B-B

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN		Revision History:	
			SHEET TITLE: Sectional Details (Section on B-B, C-C & D-D)		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-04-A-008	

TENDER DRAWINGS

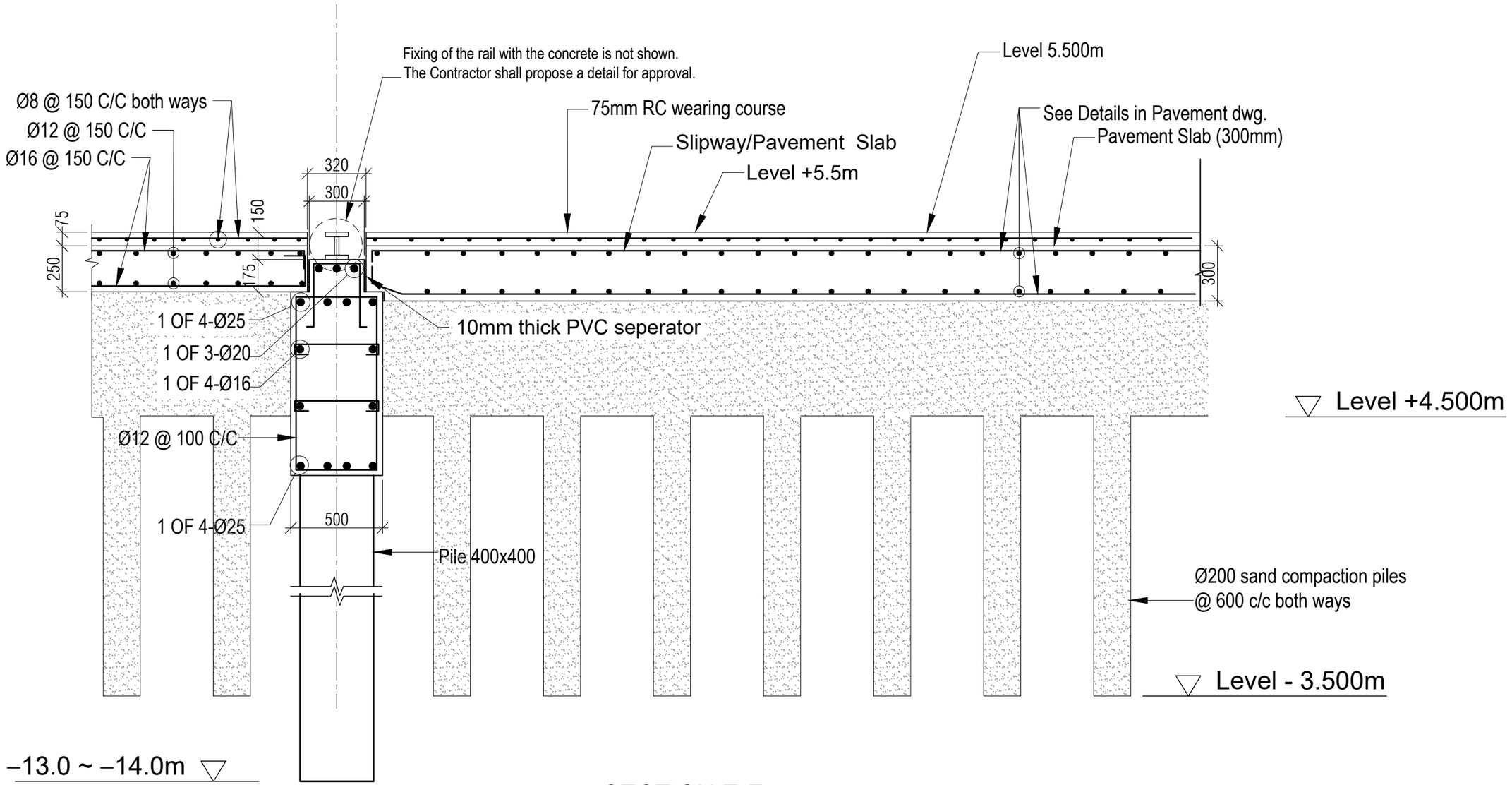


Note: The variable overhang dimension 'A' of the berth rail beam shall depend on how much the cradle/trolley shall be overhang towards the storm drain. Depending on the detailed dimension of the cradle/trolley, 'A' can vary between 300 to 750 mm.

SECTION C-C

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Sectional Details (Section on B-B, C-C & D-D) CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-009	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



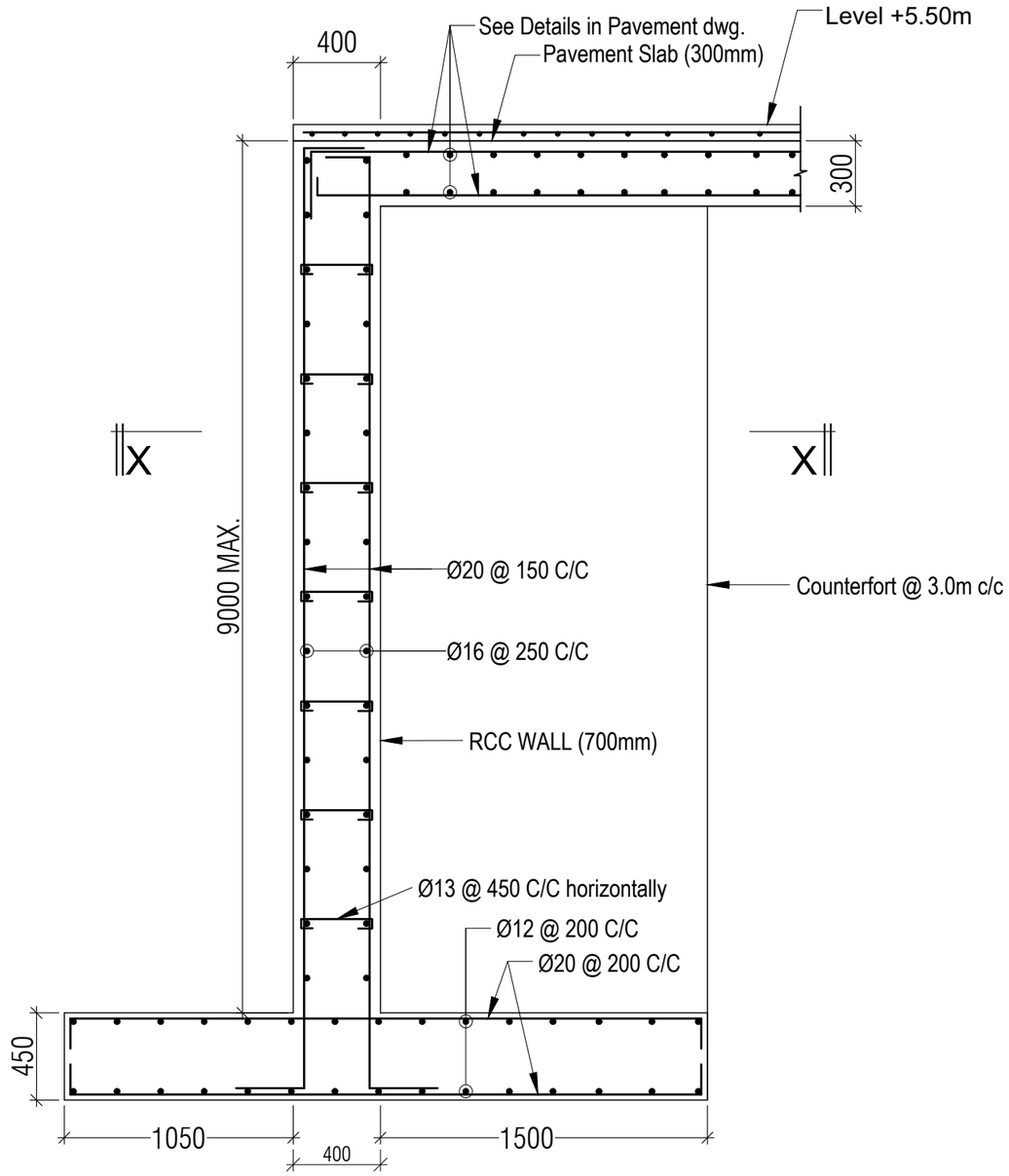
SECTION E-E

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Sectional Details (Section on B-B, C-C & D-D) CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN

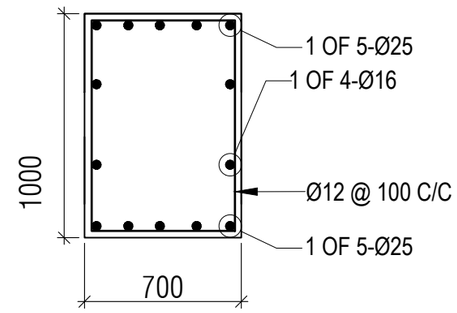
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-04-A-010

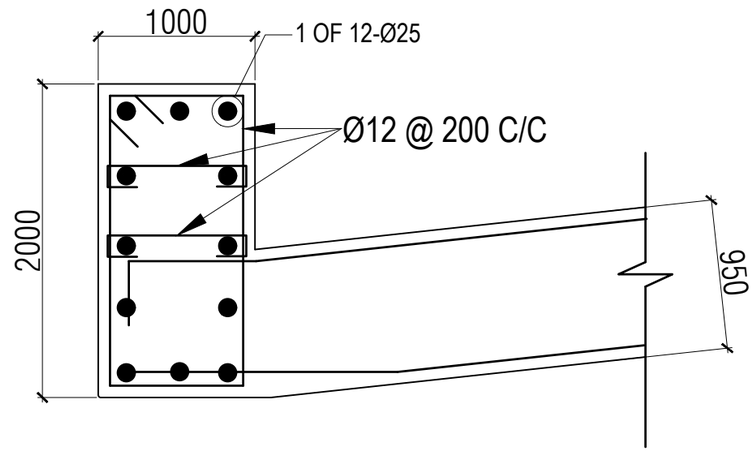
TENDER DRAWINGS



SECTION D-D



TYPICAL SECTION OF REACTION BEAM AND CROSS BEAM

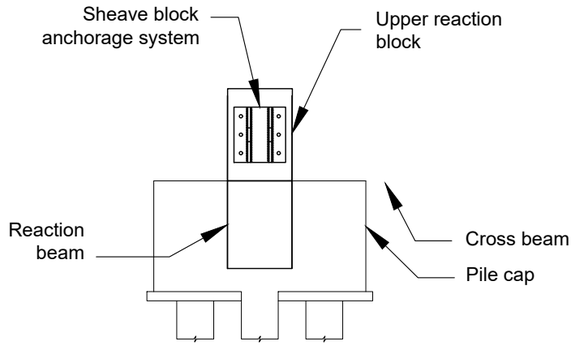


TYPICAL SECTION OF SLIPWAY END BEAM

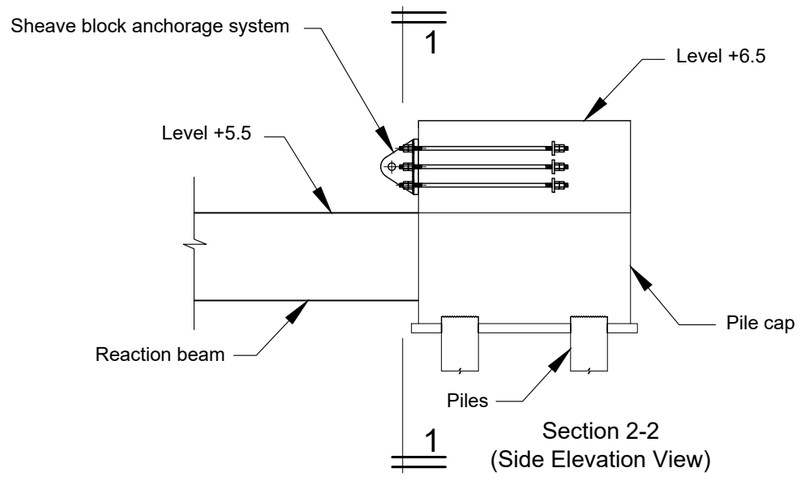
Note: See sheet 05 for details of Sec X-X

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN	Revision History:	
			SHEET TITLE: Sectional Details (Section on B-B, C-C & D-D)	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-04-A-011	

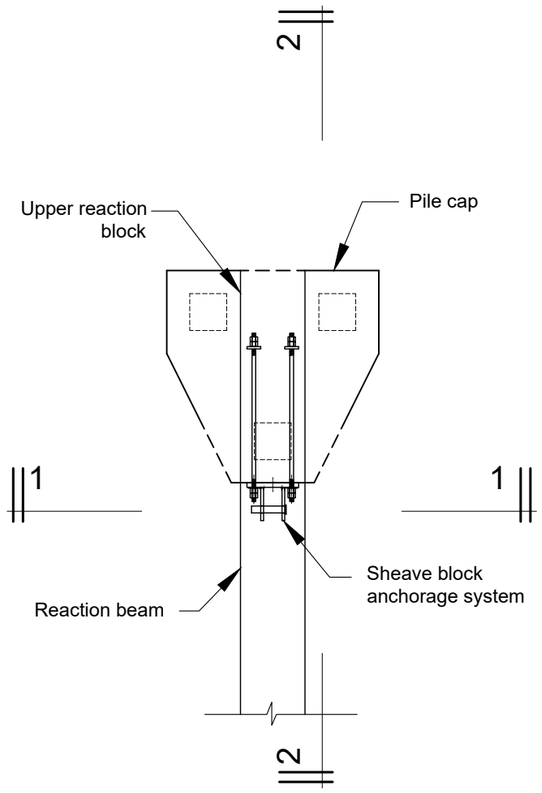
TENDER DRAWINGS



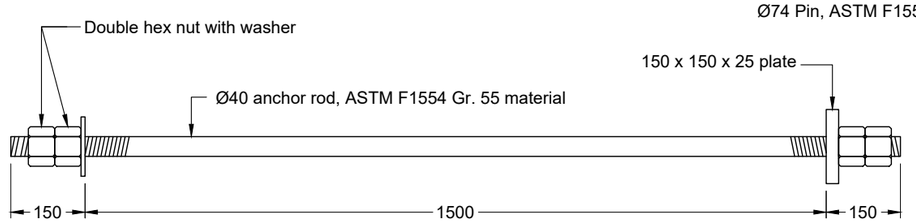
Section 1-1
(Front Elevation View)



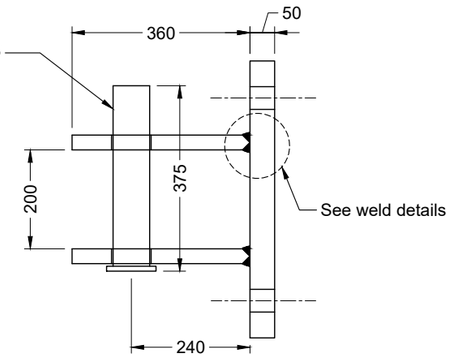
Section 2-2
(Side Elevation View)



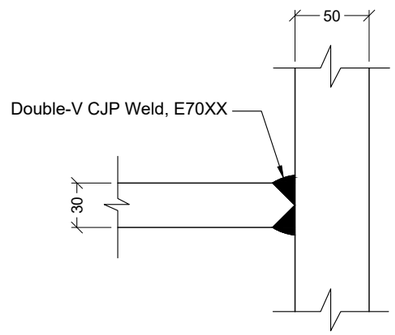
Detail-A
(Plan View)



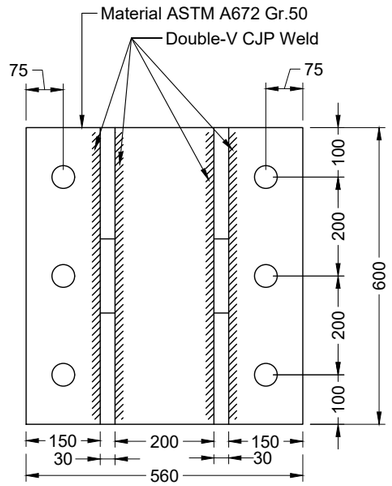
Details of anchor rod



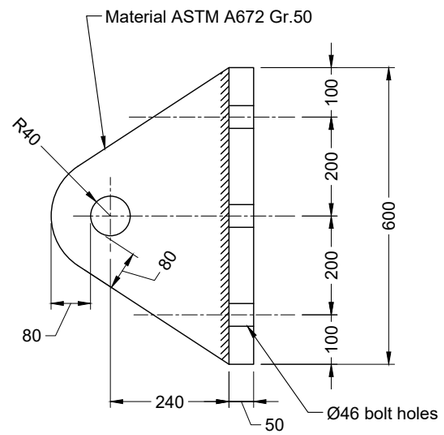
TOP VIEW



Weld details



FRONT VIEW

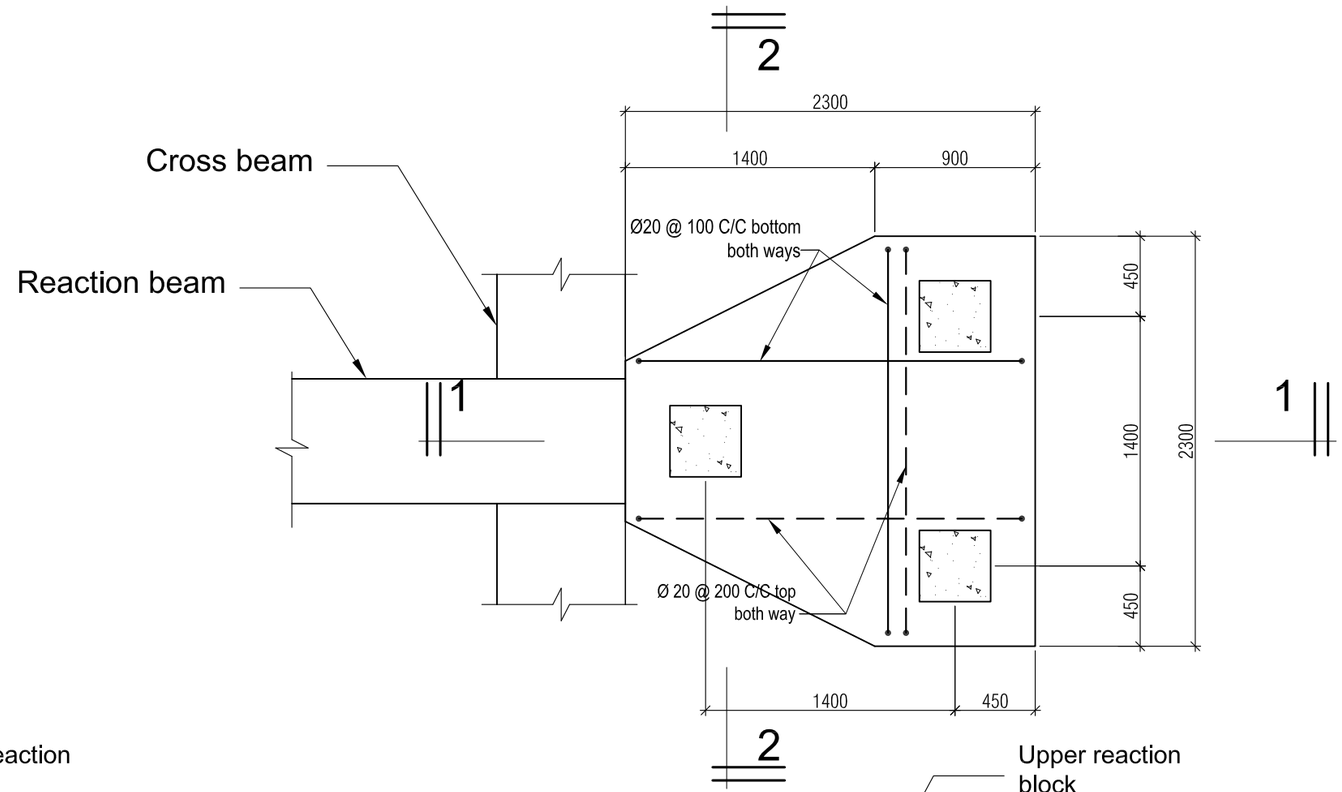


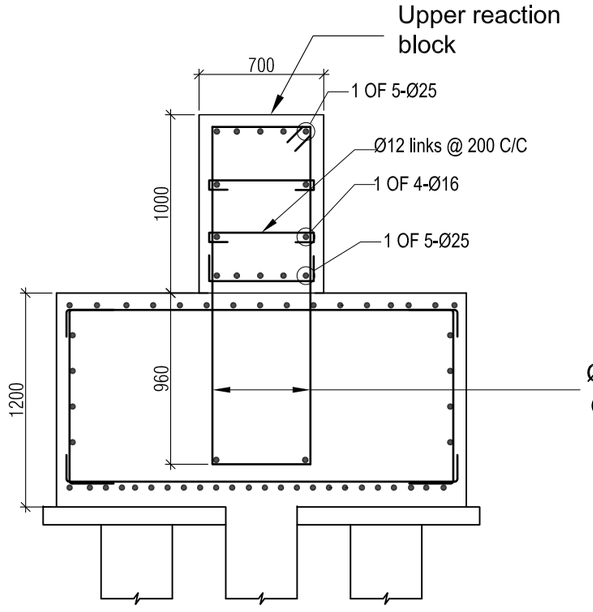
SIDE VIEW

DETAILS OF SHEAVE BLOCK ANCHORAGE SYSTEM

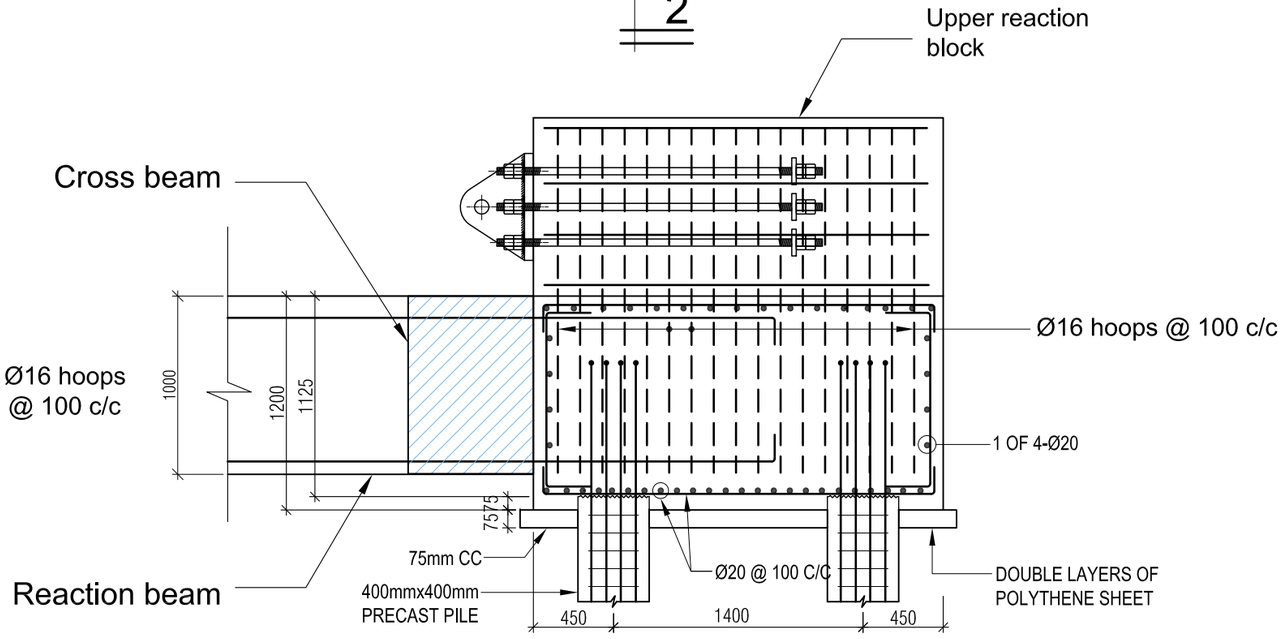
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Details of Foundation for Sheave Block Anchorage System CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-012	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS





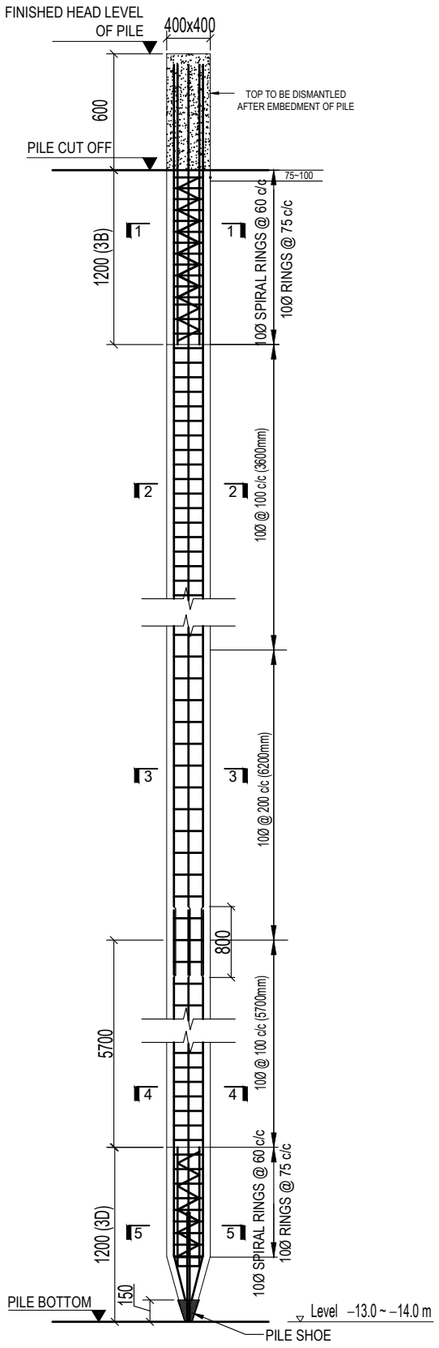
SECTION ON PILE CAP 1-1



SECTION ON PILE CAP 1-1

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Reinforcement Details of Sheave Block Anchorage Foundation	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-04-A-013	

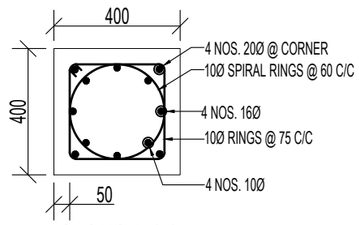
TENDER DRAWINGS



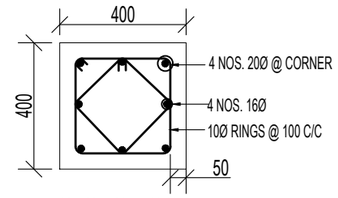
REINFORCEMENT DETAILS OF PILE

Pile length = 18.0m (approx.)

Note: For sheave block anchorage pile-cap, the length of piles shall be 22.0m (approx.) and the bottom of the piles shall be at level -18.0m



SECTION: 1-1



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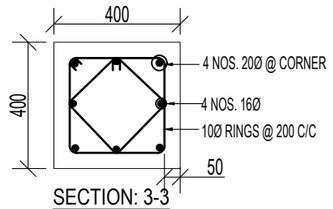
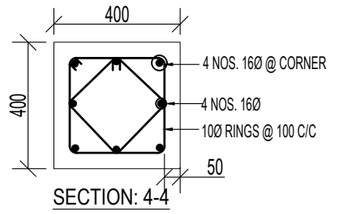
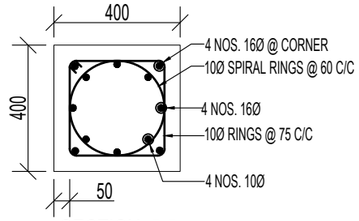


SECTION: 3-3



SECTION: 4-4

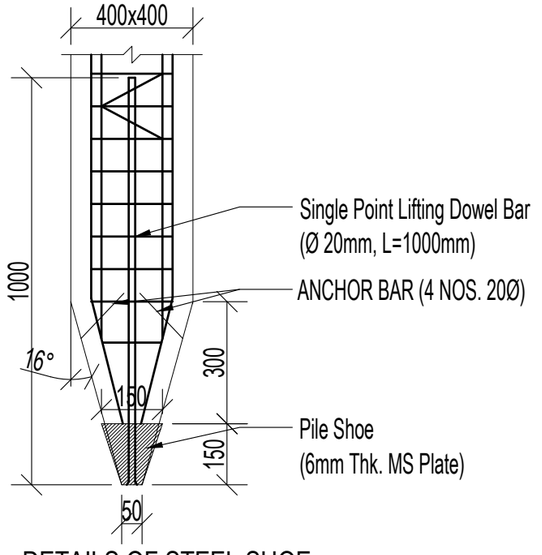


SECTION: 5-5

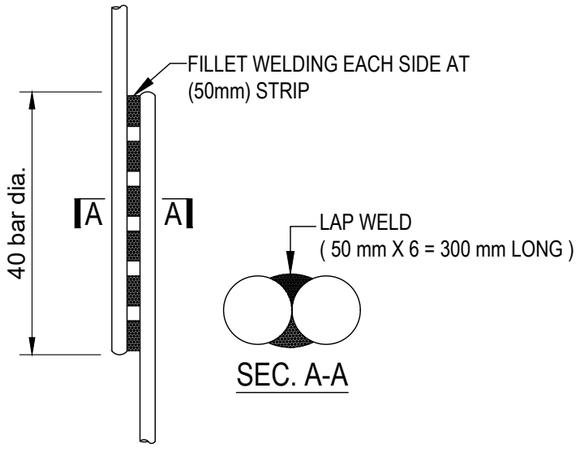
NOTE FOR PILE (Length 18.0m) :

Pile bottom at −13.0 ~ −14.0 m
Allowable compression capacity: 45.0 ton
Allowable uplift capacity: 15.0 ton
Factor of safety: 2.50

Pile bottom at −18.0 m
Allowable compression capacity: 40.0 ton
Allowable uplift capacity: 25.0 ton
Factor of safety: 2.50



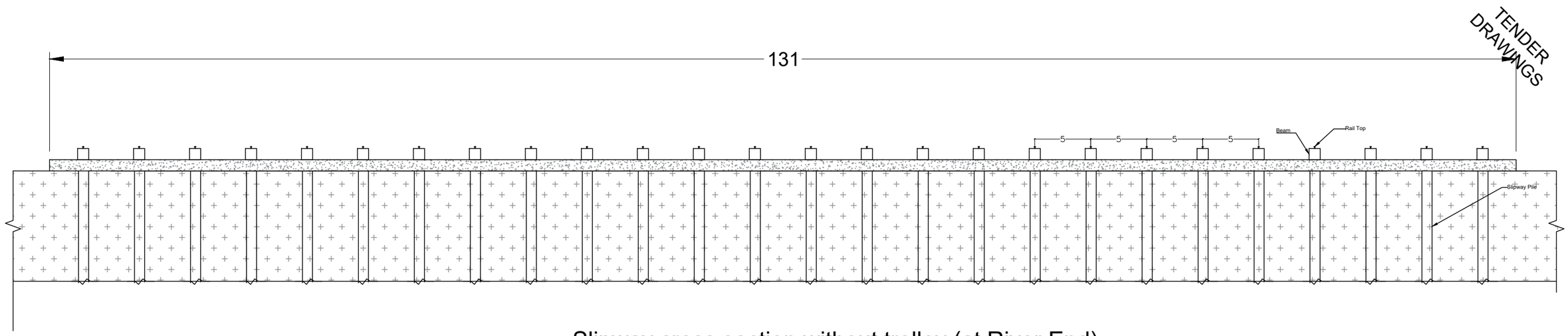
DETAILS OF STEEL SHOE



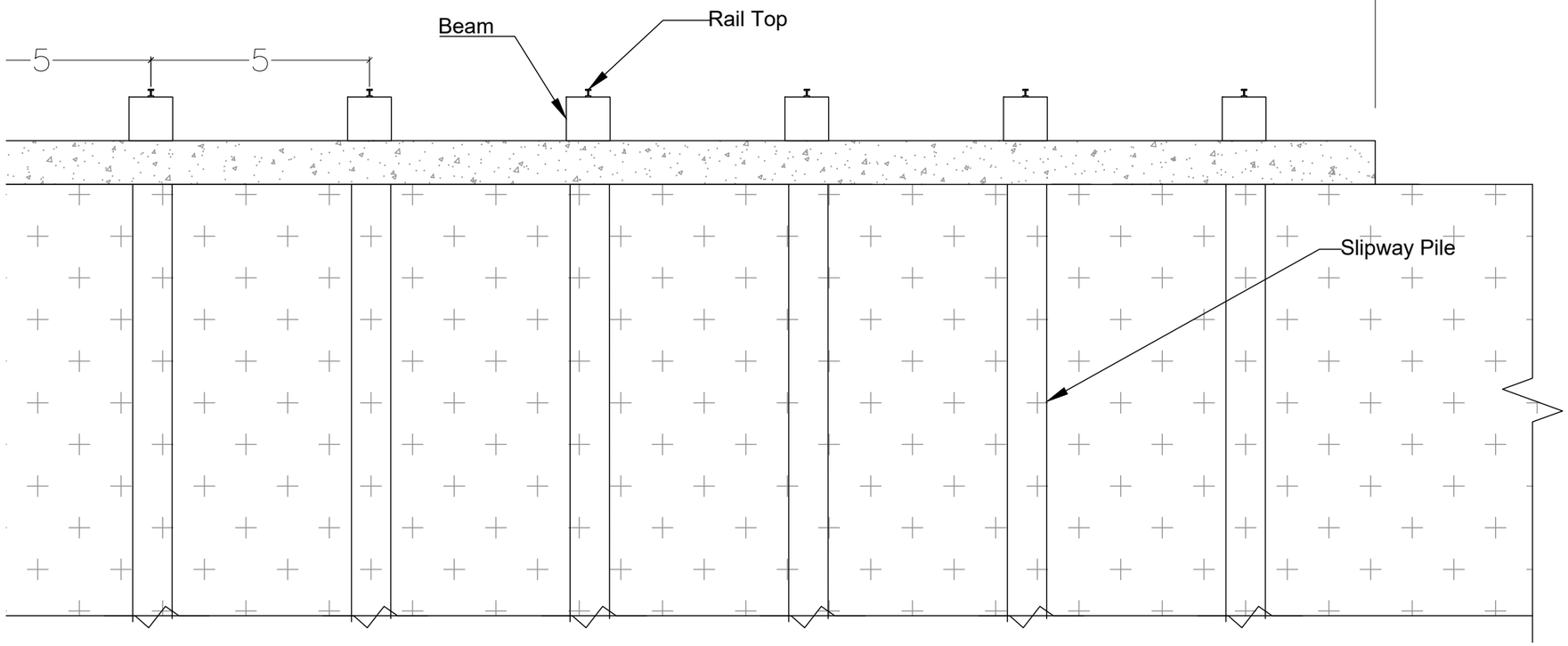
SEC. A-A

LAP DETAIL

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Pile Details for Slipway CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-014	 Date: 30-Apr-2025 Status: Revision: R-00

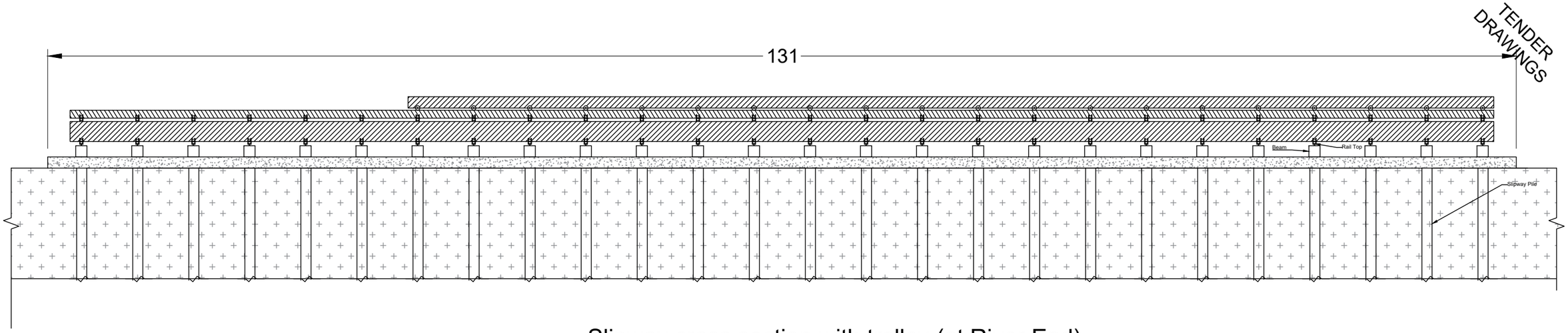


Slipway cross section without trolley (at River End)

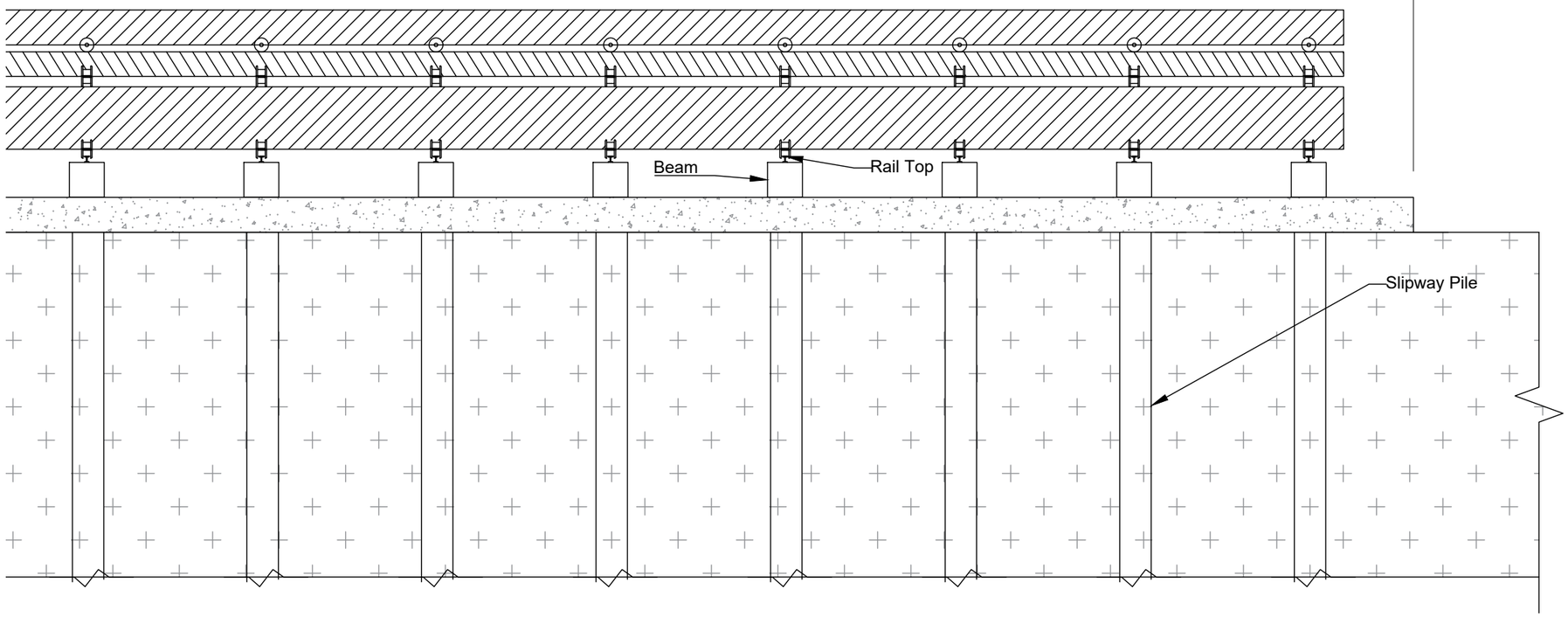


PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Slipway cross section without Trolley (at River End) CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-015	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



Slipway cross section with trolley (at River End)

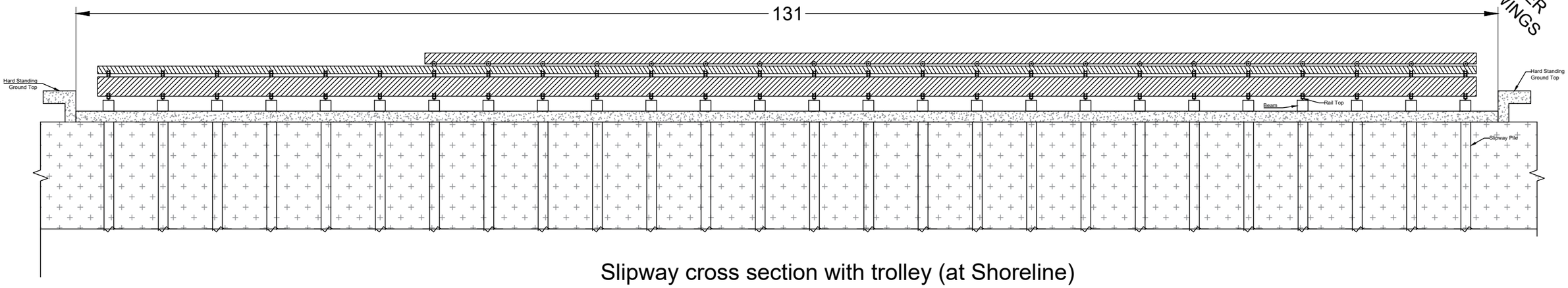


PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Slipway cross section with Trolley (at River End) CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN

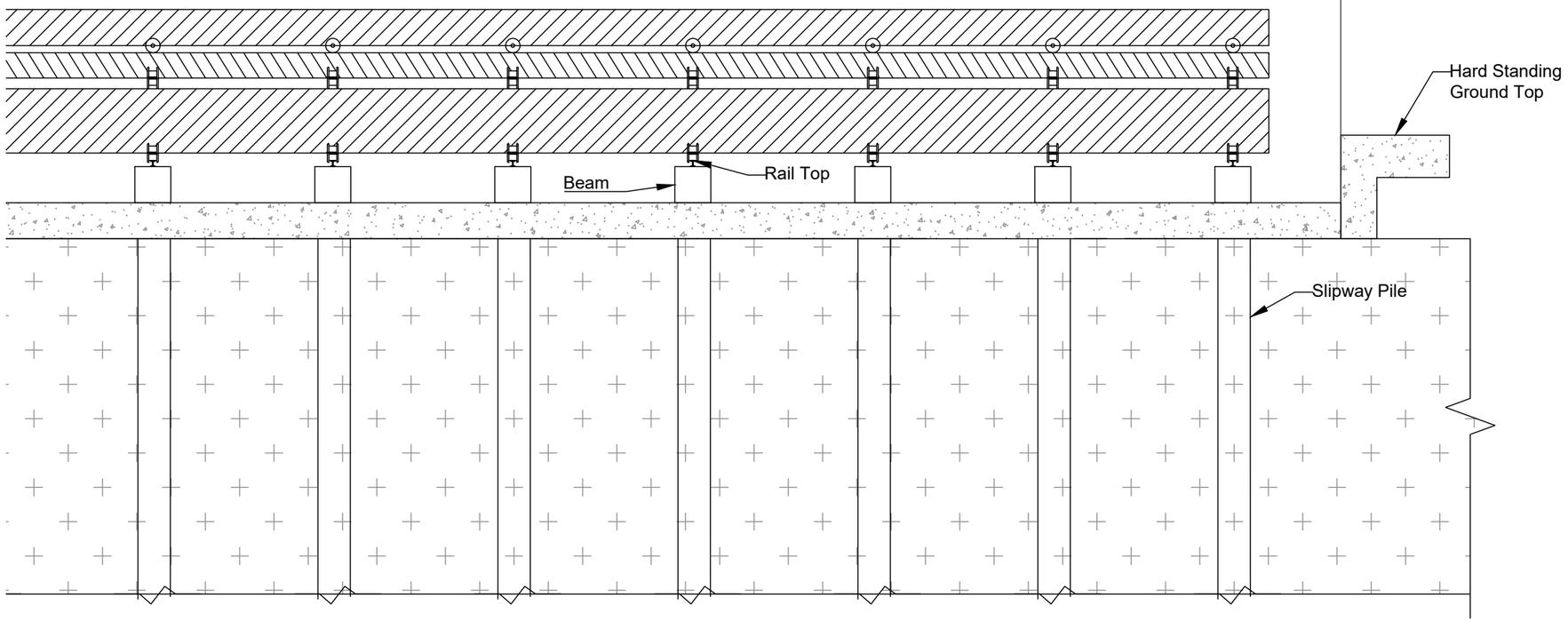
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-04-A-016

TENDER DRAWINGS



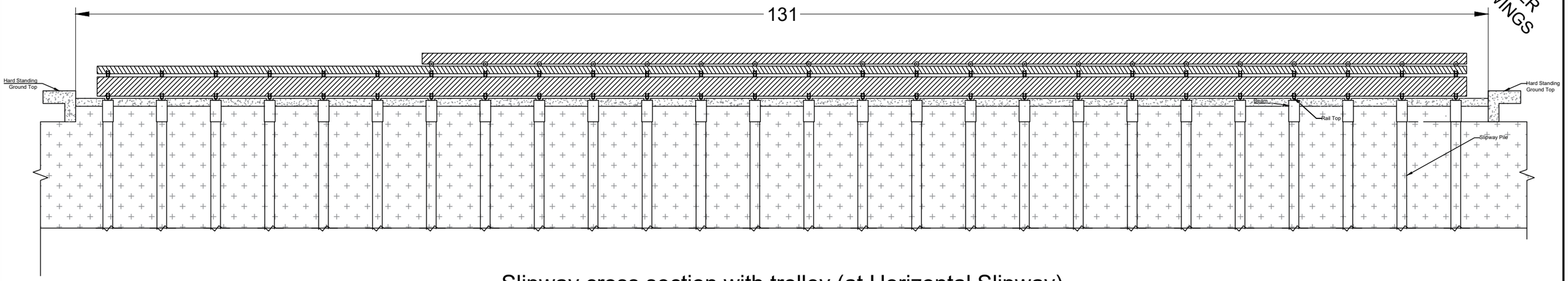
Slipway cross section with trolley (at Shoreline)



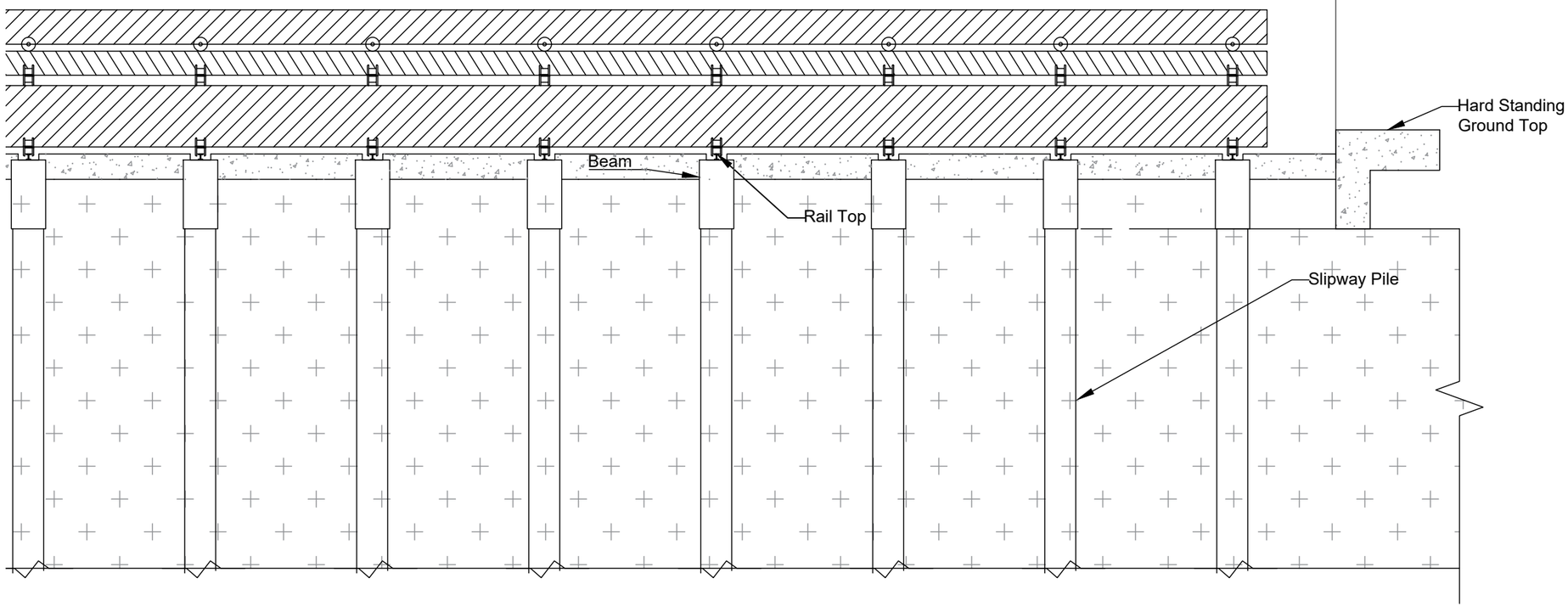
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN		Revision History:
			SHEET TITLE: Slipway cross section with Trolley (at Shoreline)		1.
					2.
					3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-04-A-017

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



Slipway cross section with trolley (at Horizontal Slipway)

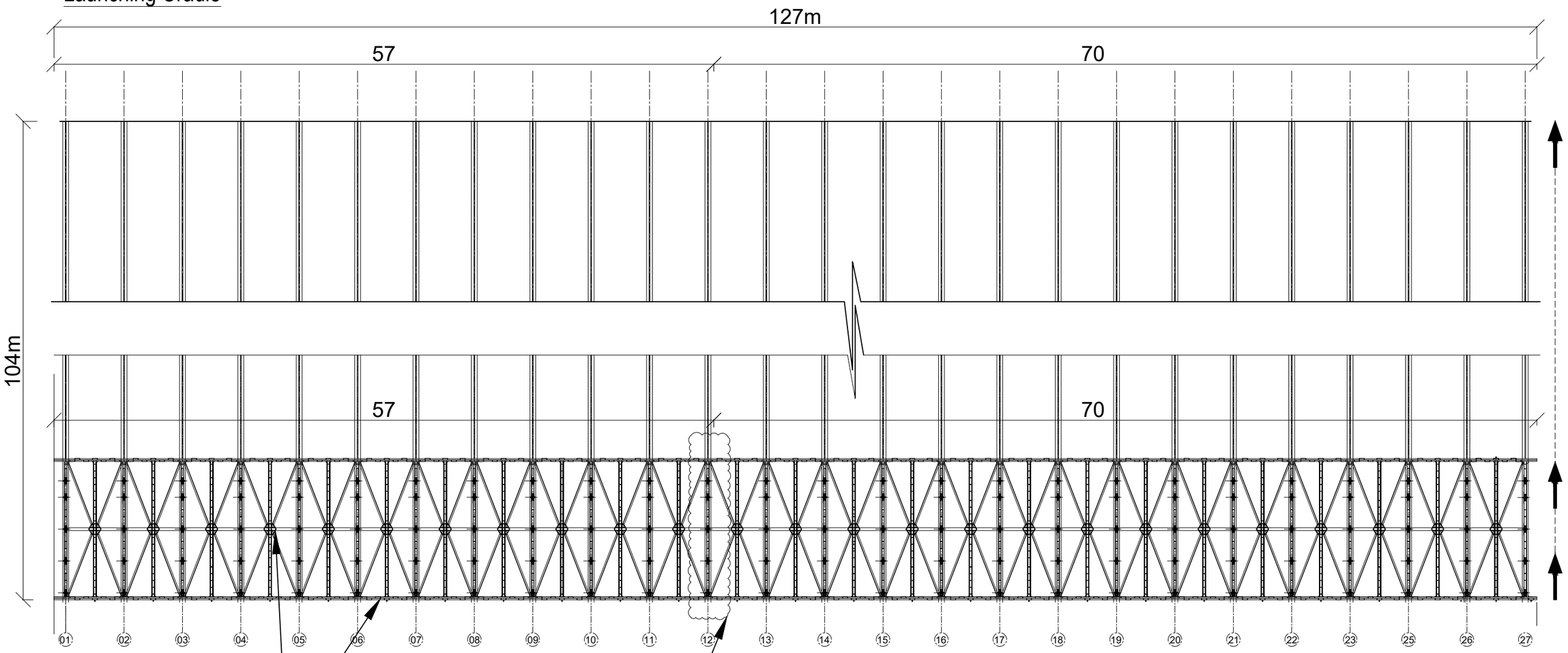


PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY STRUCTURAL DESIGN SHEET TITLE: Slipway cross section with Trolley (at Horizontal Slipway) CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-A-018	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

Cradle Movement on Slipway Slope

Launching Cradle



Plan View

Launching Cradle Detail a-1

The Launching Cradle should be constructed in 2 continuous parts having length of 70m & 57m

Note:

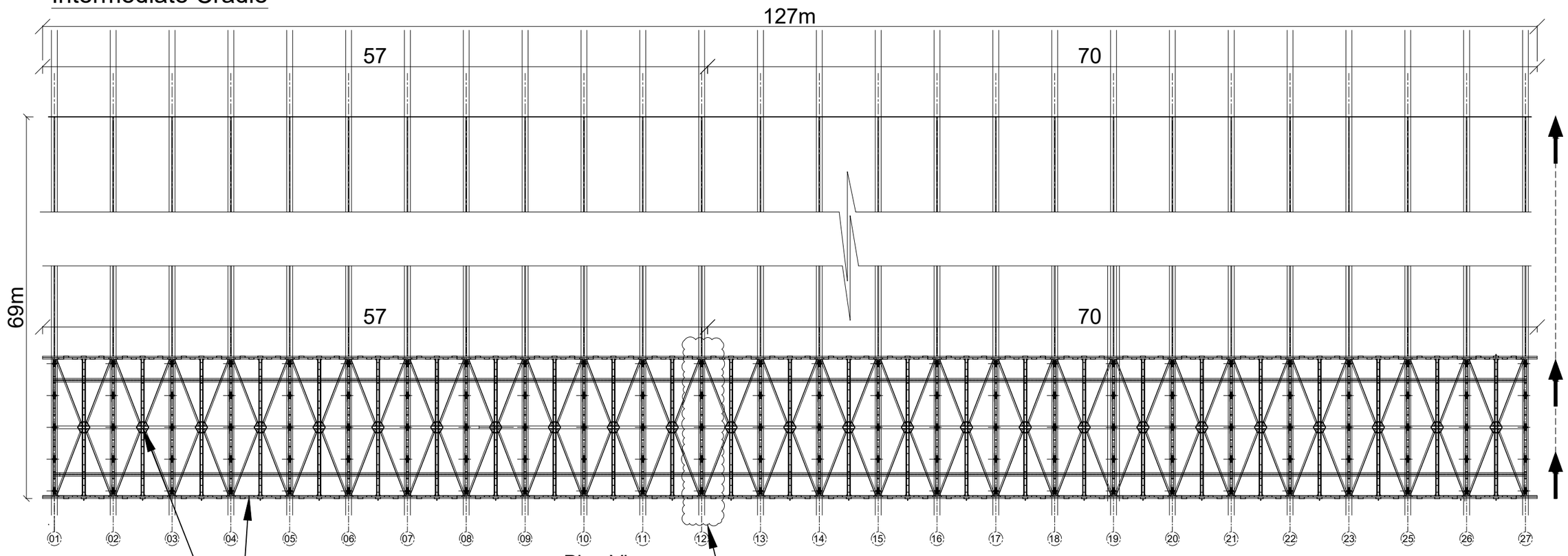
- # Top & Middle Trolley will have two parts. One should be 70m another one 57 in length. Each segment of the Top Trolley should be detachable.
- # Number of these blocks will vary depending on size & weight.
- # All measurement in meter

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL	Revision History:	
			SHEET TITLE: Cradle Movement on Slipway Slope	1.	Date: 30-Apr-2025
				2.	Status: Conceptual Design
				3.	Revision: R-01
			CAD BY: UTPOL SAHA — SCALE: AS SHOWN	Drg No. D-04-B-001	

TENDER DRAWINGS

Cradle Movement on Slipway Horizontal Area

Intermediate Cradle



Plan View

Intermediate Cradle Detail a-2

The Intermediate Cradle should be constructed in 2 continuous parts having length of 70m & 57m

Note:

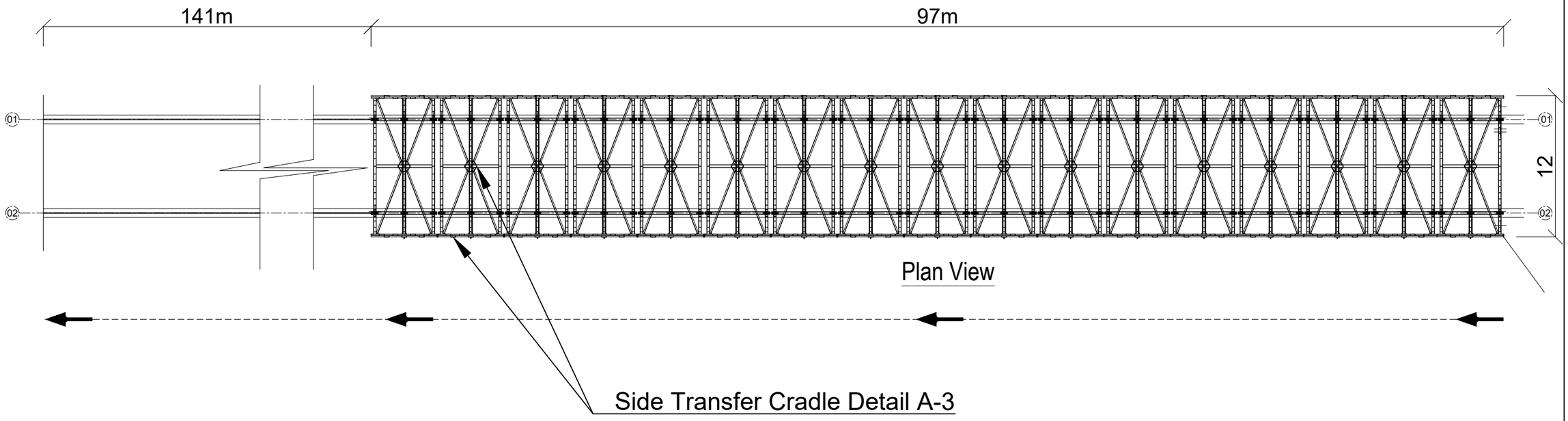
All measurement in meter

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL	Revision History:	
			SHEET TITLE: Cradle Movement on Slipway Horizontal Area	1.	Date: 30-Apr-2025
				2.	Status: Conceptual Design
				3.	Revision: R-01
			CAD BY: UTPOL SAHA / SCALE: AS SHOWN	Drg No. D-04-B-002	

TENDER DRAWINGS

Cradle Movement from Slipway Horizontal Area to Repair Facility

Side Transfer Cradle



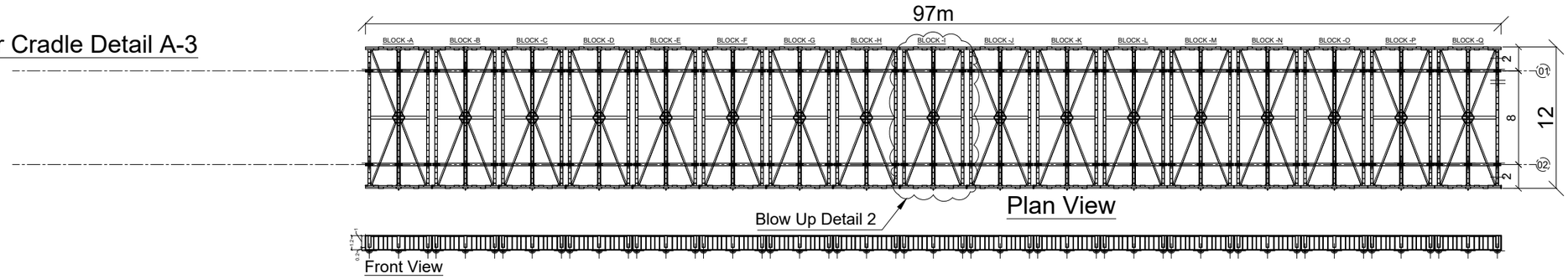
Note:

\# All measurement in meter

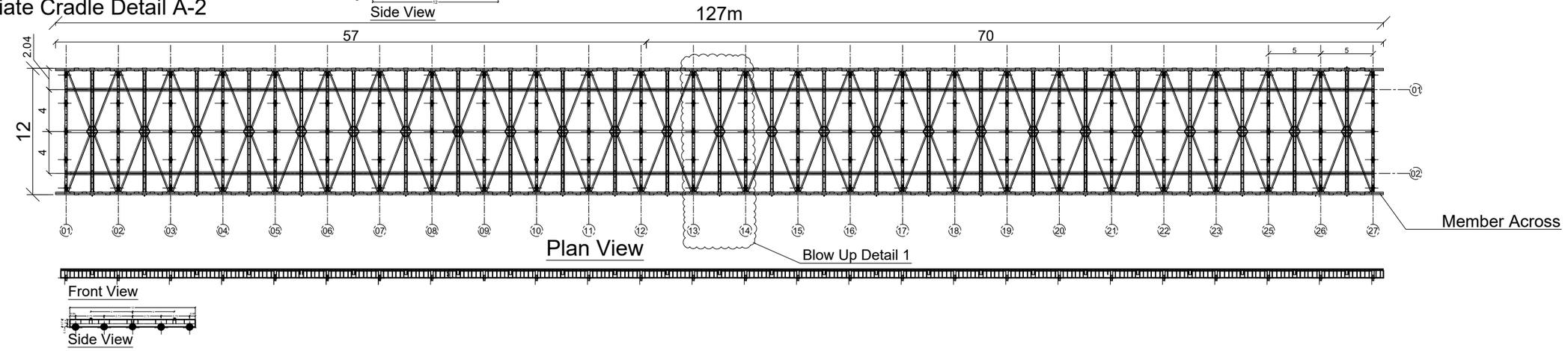
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL	Revision History:	
			SHEET TITLE: Cradle Movement from Slipway Horizontal Area to Repair Facility	1.	Date: 30-Apr-2025
				2.	Status: Conceptual Design
				3.	Revision: R-01
			CAD BY: UTPOL SAHA — SCALE: AS SHOWN	Drg No. D-04-B-003	

TENDER DRAWINGS

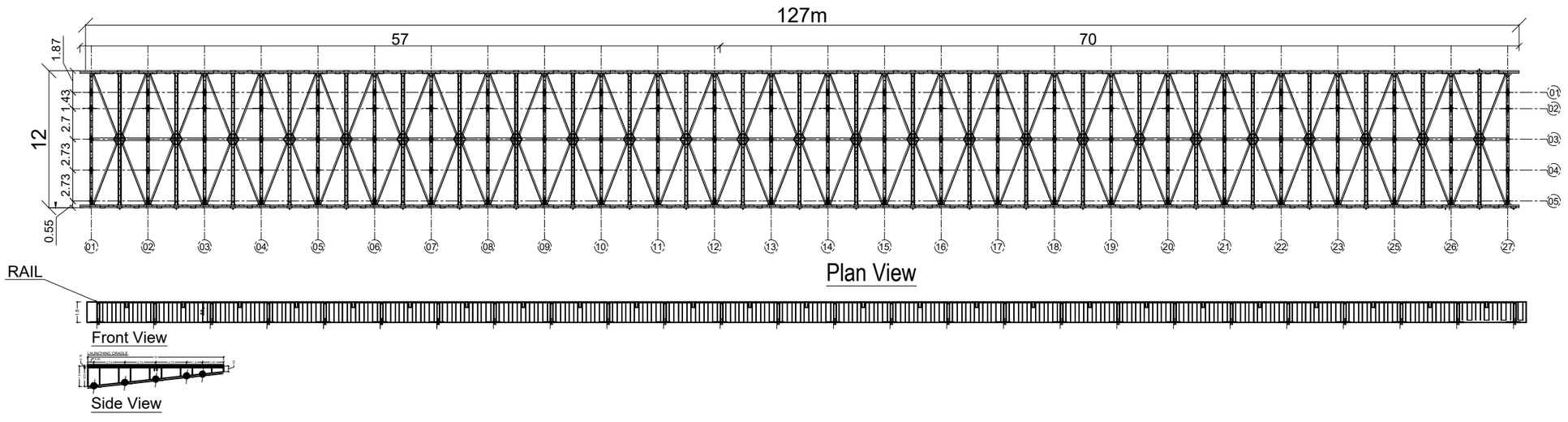
Side Transfer Cradle Detail A-3



Intermediate Cradle Detail A-2



Launching Cradle Detail A-1



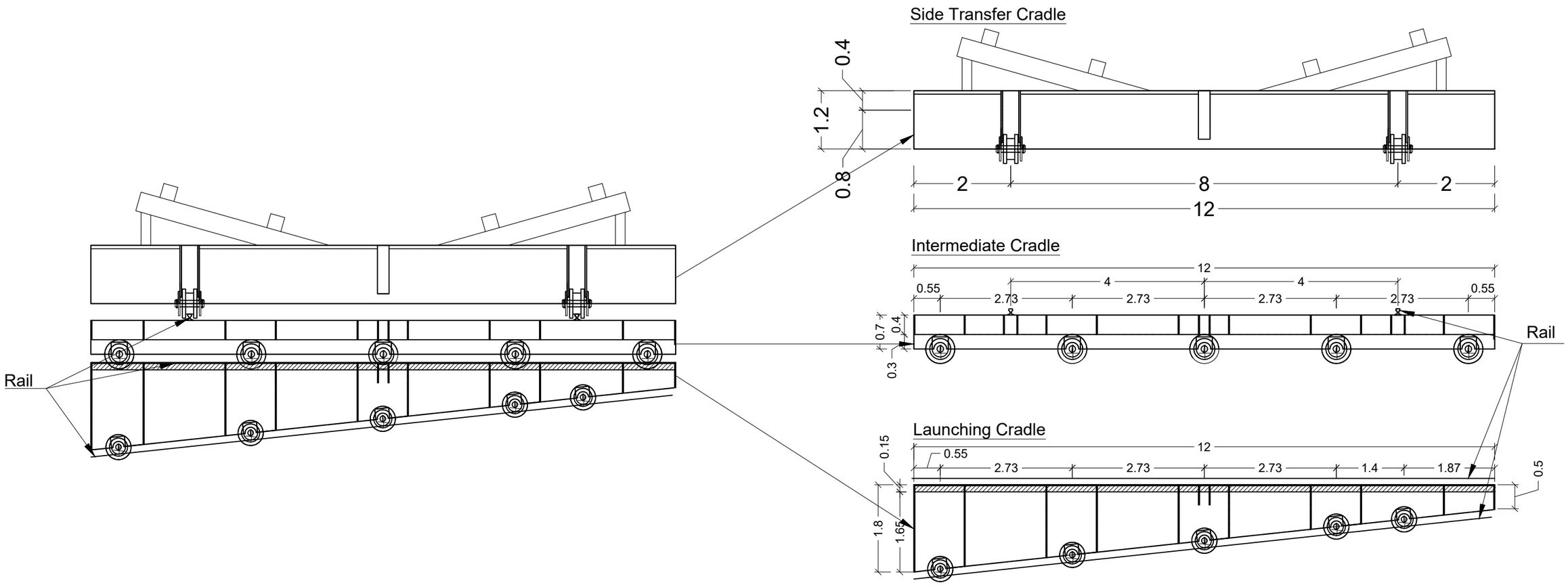
Note:

\# All measurement in meter

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL SHEET TITLE: Cradle Detail A-1,A-2,A-3 CAD BY: UTPOL SAHA — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-B-004	 Date: 30-Apr-2025 Status: Conceptual Design Revision: R-01

TENDER DRAWINGS

Cradle Side View Detail



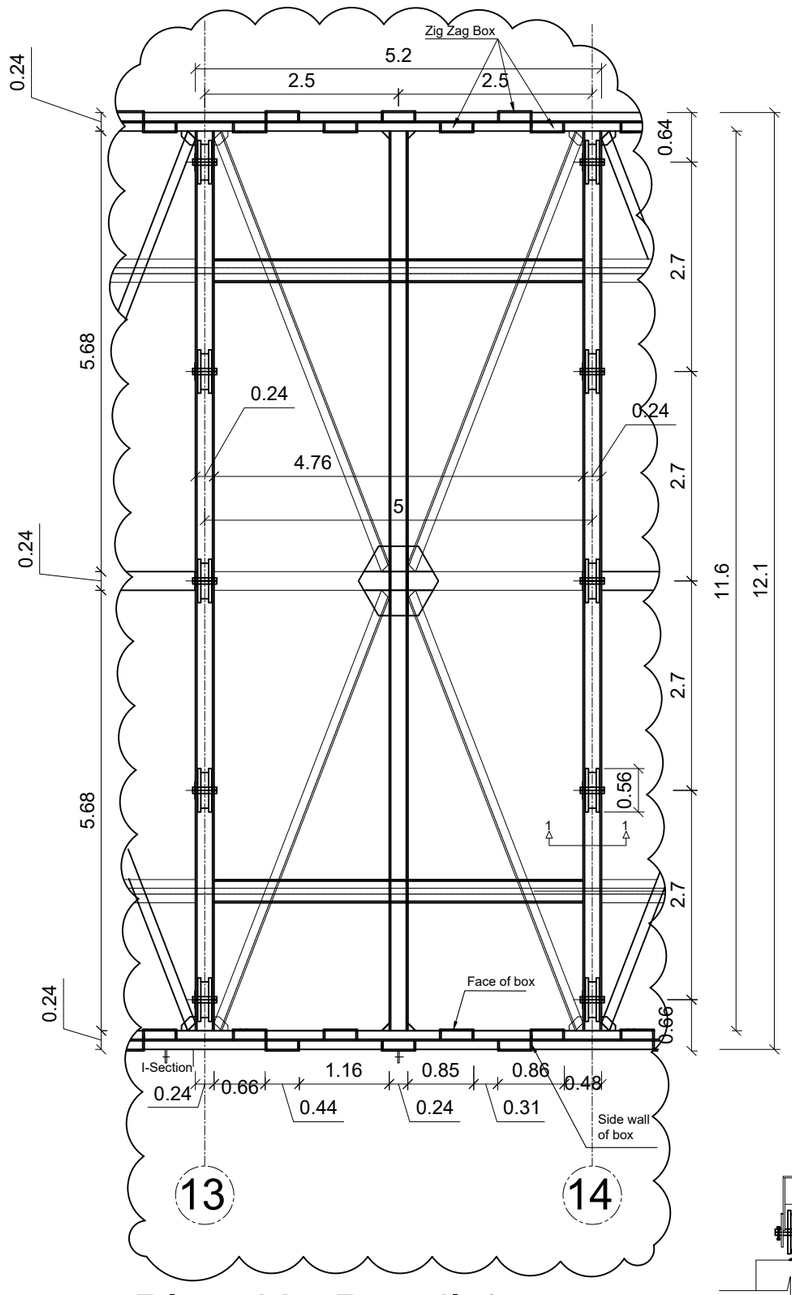
Note:

\# All measurement in meter

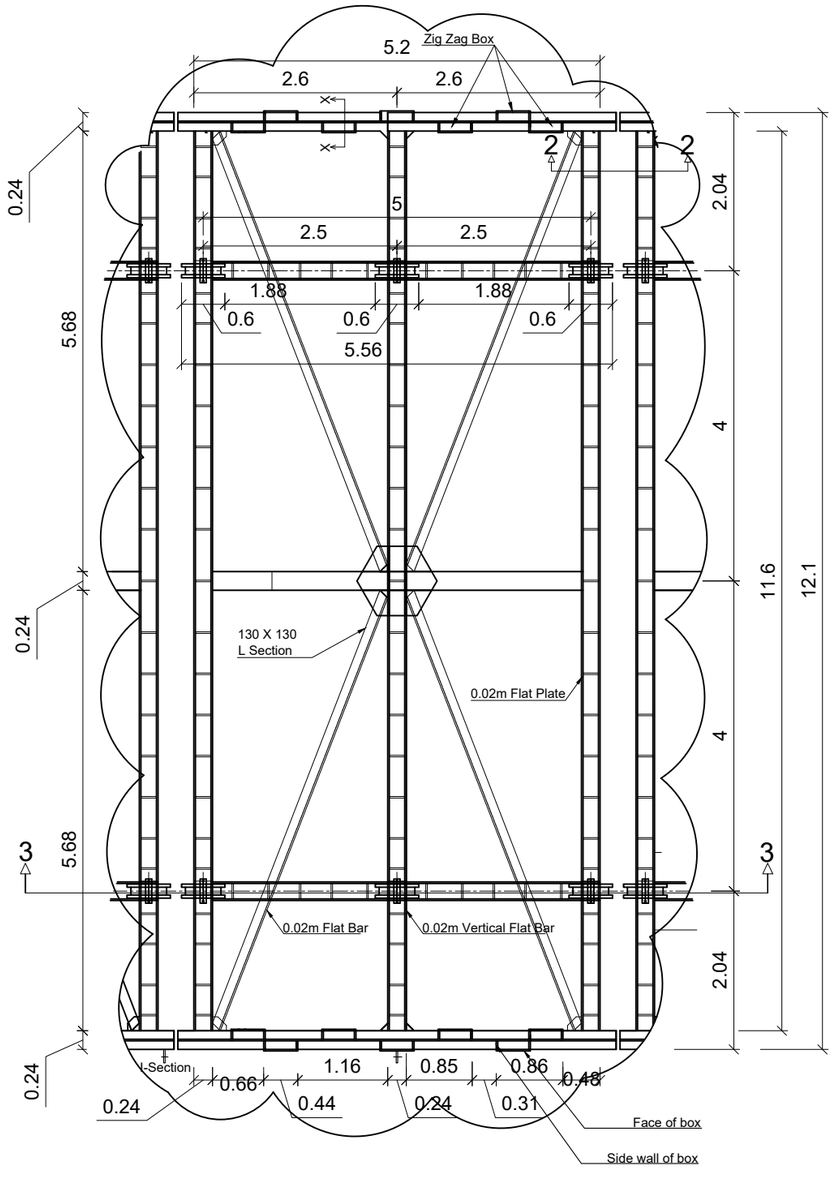
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL	Revision History:	
			SHEET TITLE: Cradle Side View Detail	1.	Date: 30-Apr-2025
				2.	Status: Conceptual Design
				3.	Revision: R-01
			CAD BY: UTPOL SAHA / SCALE: AS SHOWN	Drg No. D-04-B-005	

TENDER DRAWINGS

Block -I



Blow Up Detail 1

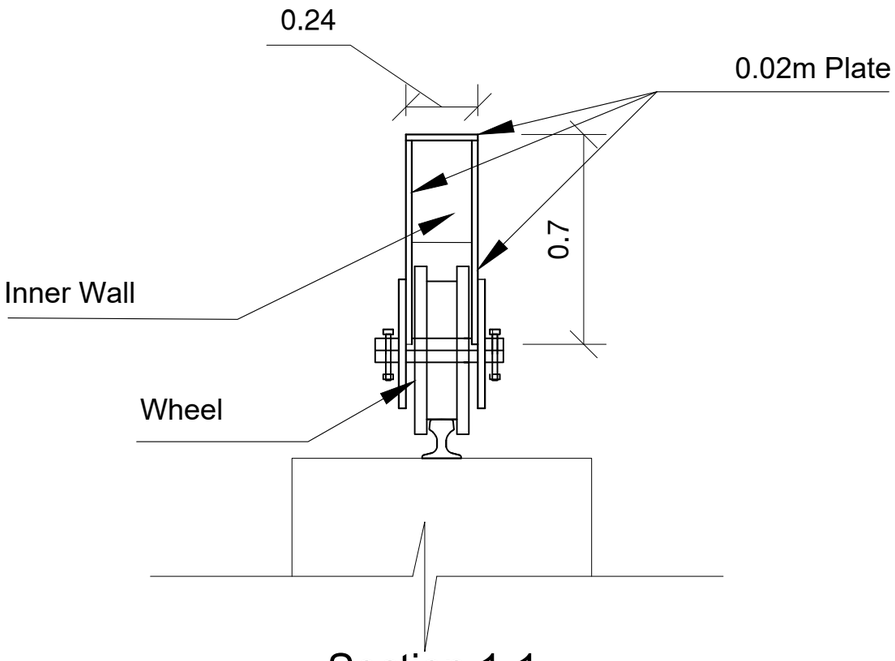


Blow Up Detail 2

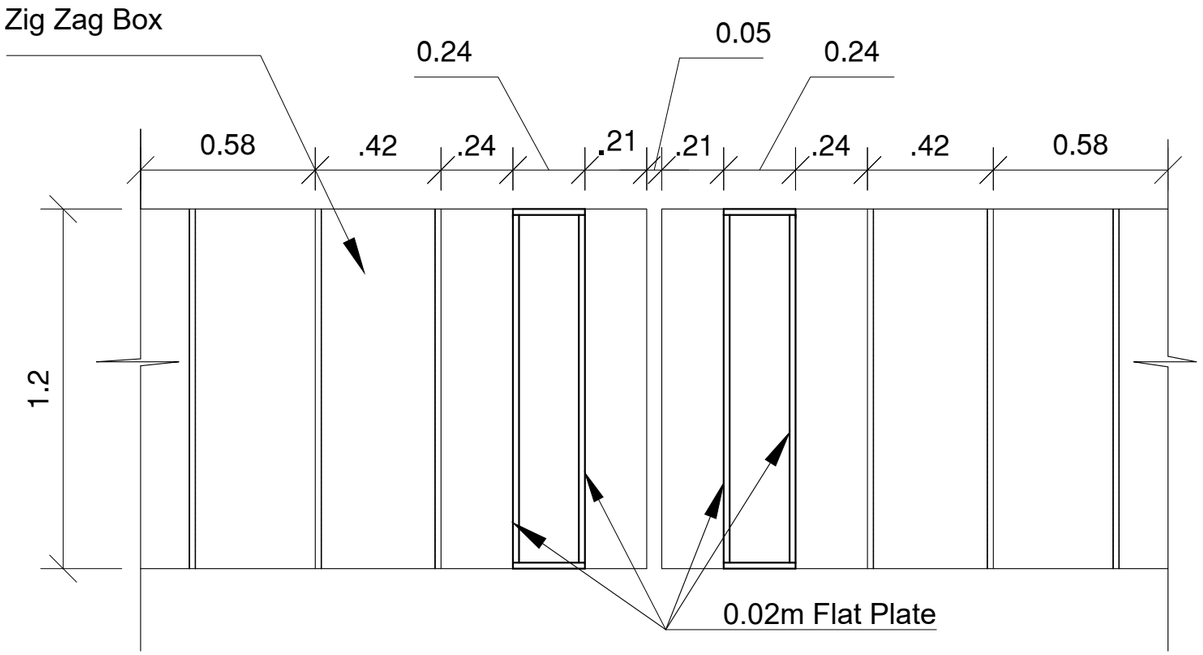
Note:

\# All measurement in meter

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL SHEET TITLE: Blow Up Detail 1&2 CAD BY: UTPOL SAHA SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-04-B-006	Date: 30-Apr-2025 Status: Conceptual Design Revision: R-01

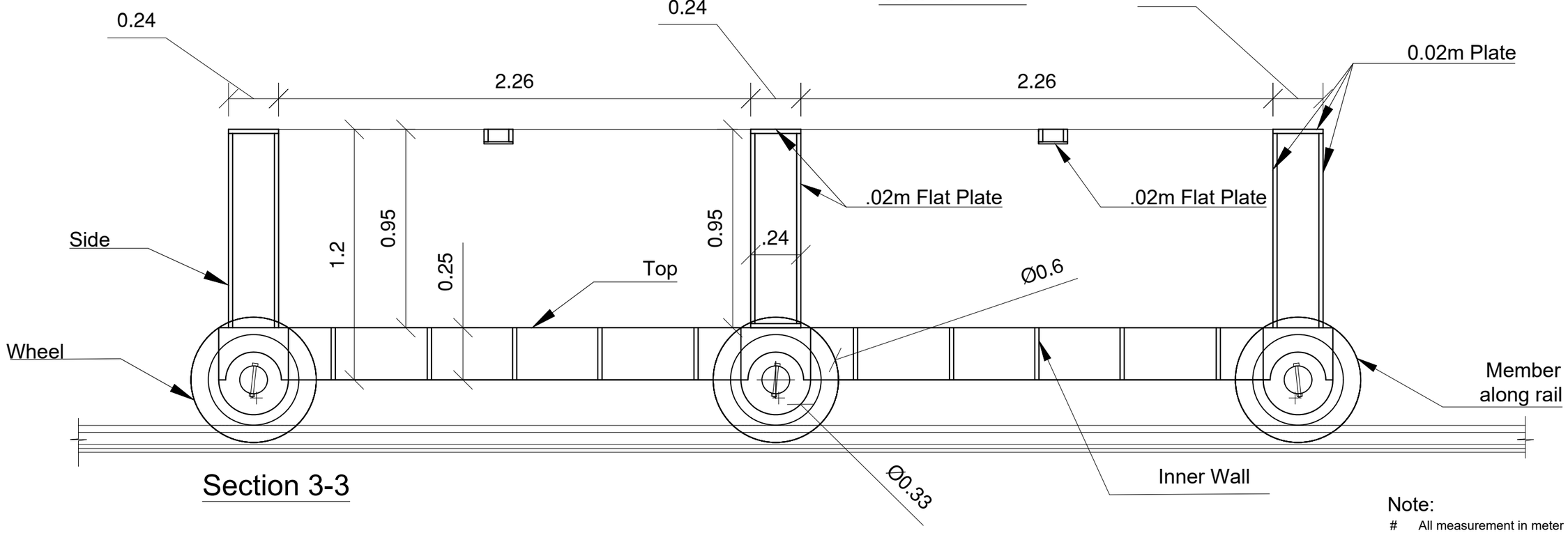


Section 1-1



Section 2-2

TENDER DRAWINGS

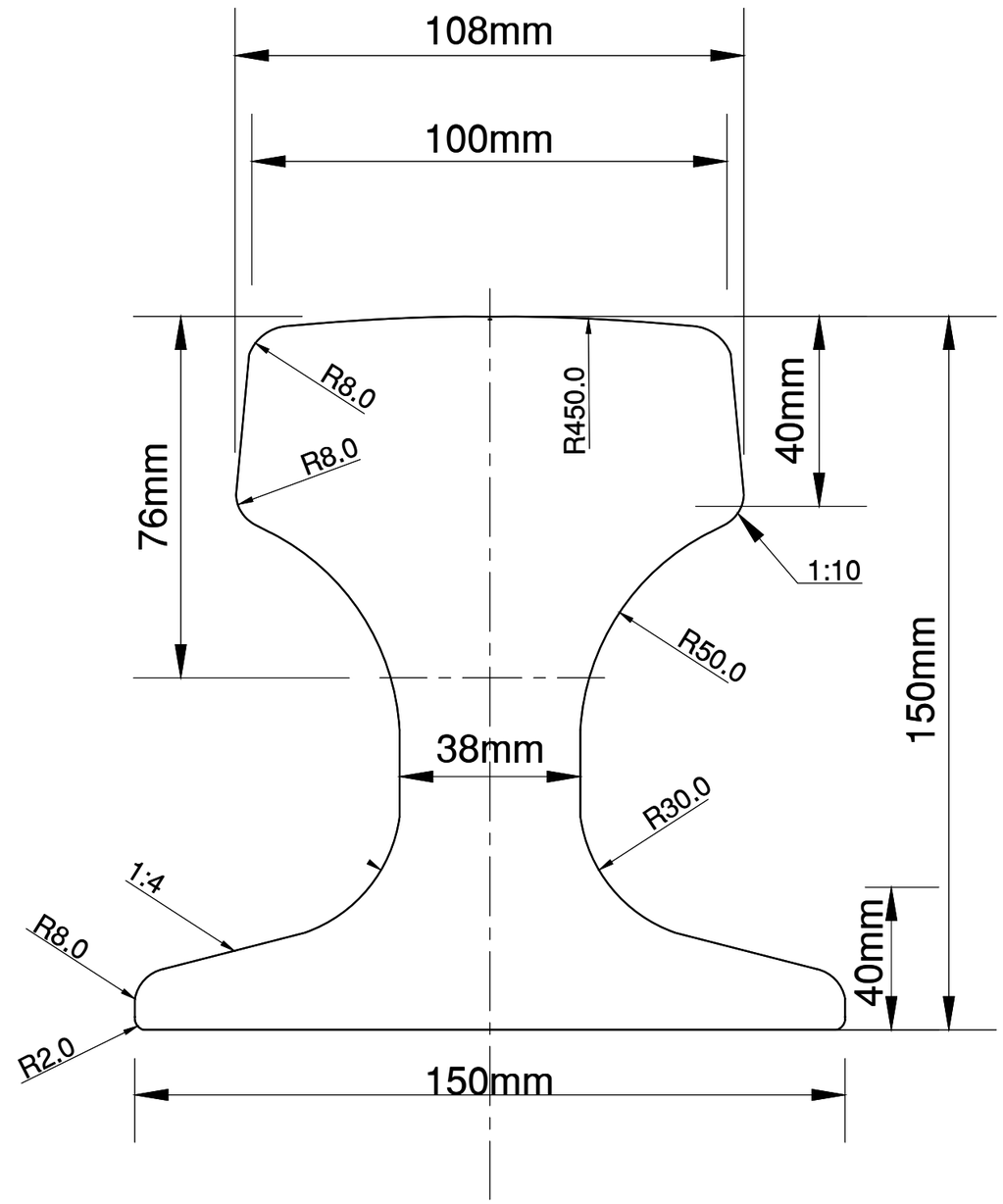


Section 3-3

Note:
All measurement in meter

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: CRADLE DESIGN DETAIL	Revision History:	
			SHEET TITLE: Detail Section 1, 2 & 3	1.	Date: 30-Apr-2025
				2.	Status: Conceptual Design
				3.	Revision: R-01
			CAD BY: UTPOL SAHA / SCALE: AS SHOWN		Drg No. D-04-B-007

TENDER DRAWINGS



Note:

All measurement in mm

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: SLIPWAY & REPAIR FACILITY RAIL SECTION FOR REFERENCE. SHEET TITLE: Rail Section Details CAD BY: UTPOL SAHA SCALE: AS SHOWN	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision:
				Drg No. D-04-C-001	

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

SHIP REPAIR FACILITY DESIGN

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN **SHEET TITLE:** General Notes for RC Construction: 1 of 2 **CAD BY:** **SCALE:** AS SHOWN	**REVISION HISTORY:** 1. 2. 3. **DRG NO.** D-05-A-001	**DATE:** 30-Apr-2025 **STATUS:** **REVISION:** R-00

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

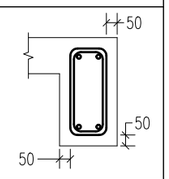
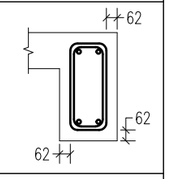
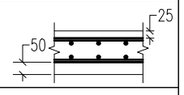
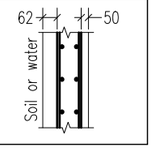
6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

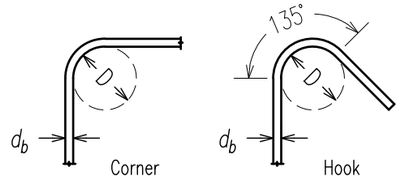
7. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Beam on ground	Top, side & bottom	50mm	
	In contact with soil or water	62mm	
Slab on ground	Top and bottom	25mm and 50mm	
R.C.C wall below ground	In contact with soil or water	62mm	
	Other	50mm	

8. BAR BENDING PIN DIAMETER FOR HOOKS AND L–BENDS

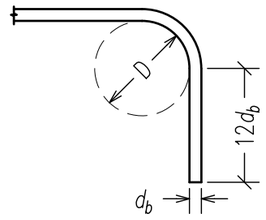
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement

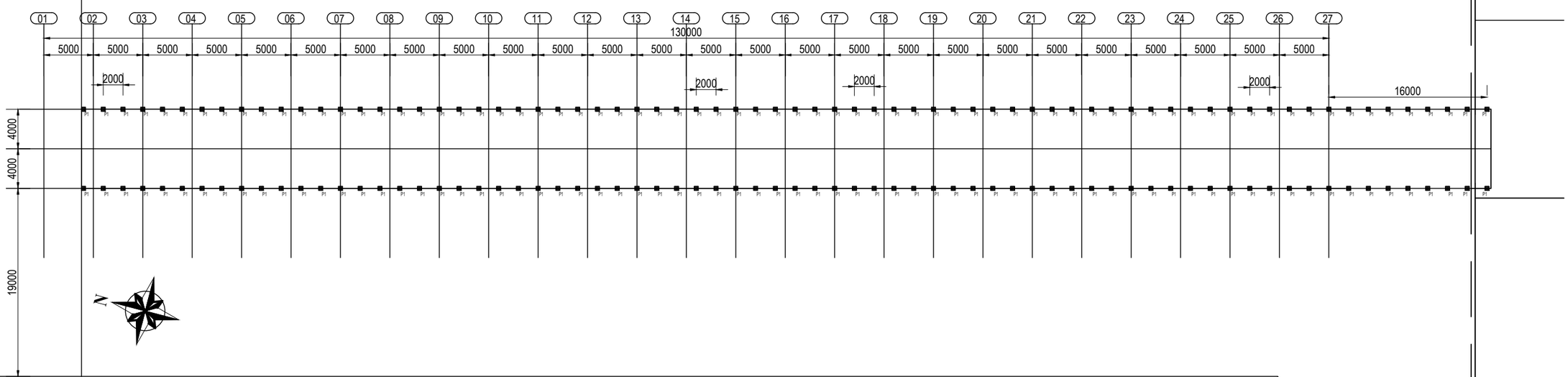


D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN **SHEET TITLE:** General Notes for RC Construction: 2 of 2 **CAD BY:** **SCALE:** AS SHOWN
			REVISION HISTORY: 1. 2. 3. **DATE:** 30-Apr-2025 **STATUS:** **REVISION:** R-00 **DRG NO.** D-05-A-002

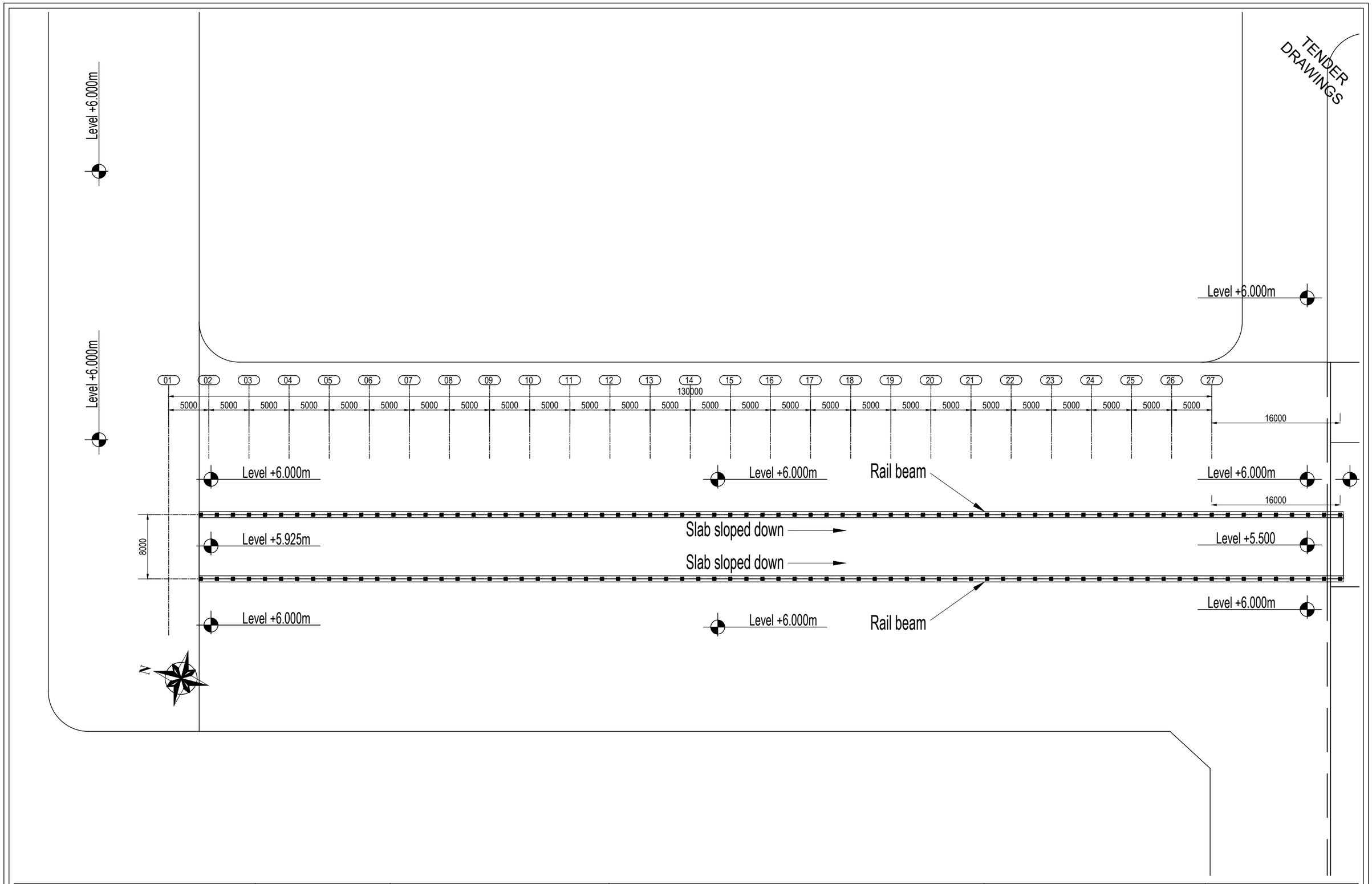
TENDER DRAWINGS



Note: See drg. sheet D-05-A-006 for pile details

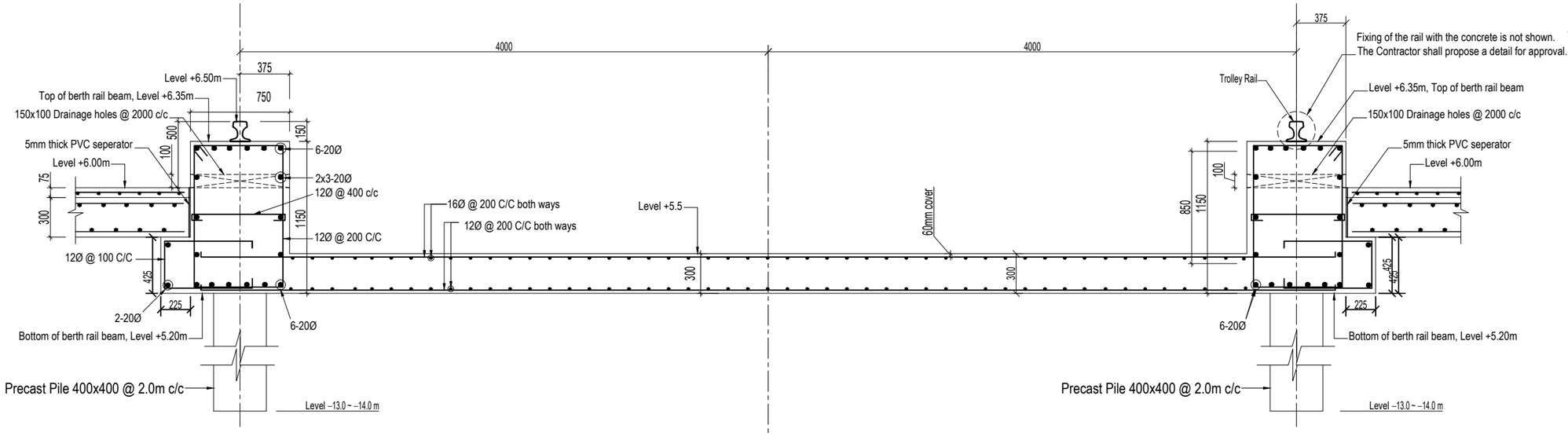
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN **SHEET TITLE:** Pile Layout Plan **CAD BY:** **SCALE:** AS SHOWN	**REVISION HISTORY:** 1. 2. 3. **DRG NO.** D-05-A-003

DATE: 30-Apr-2025
STATUS:
REVISION: R-00

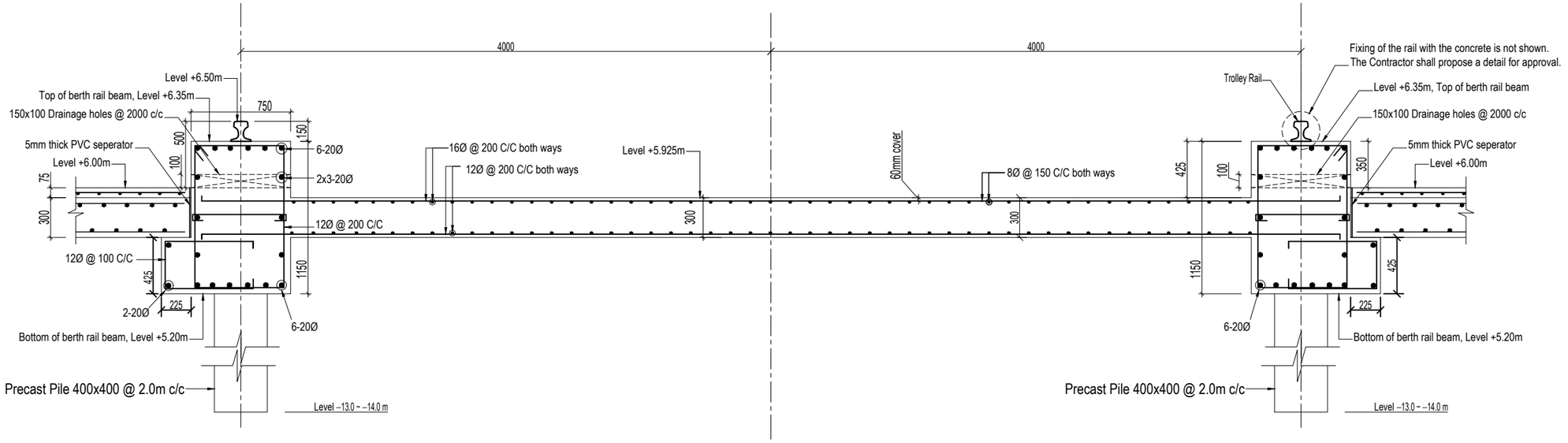


PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN **SHEET TITLE:** Rail Beam Layout Plan **CAD BY:**	**REVISION HISTORY:** 1. 2. 3. **SCALE:** AS SHOWN **DRG NO.** D-05-A-004 **DATE:** 30-Apr-2025 **STATUS:** **REVISION:** R-00

TENDER DRAWINGS



Section at South End

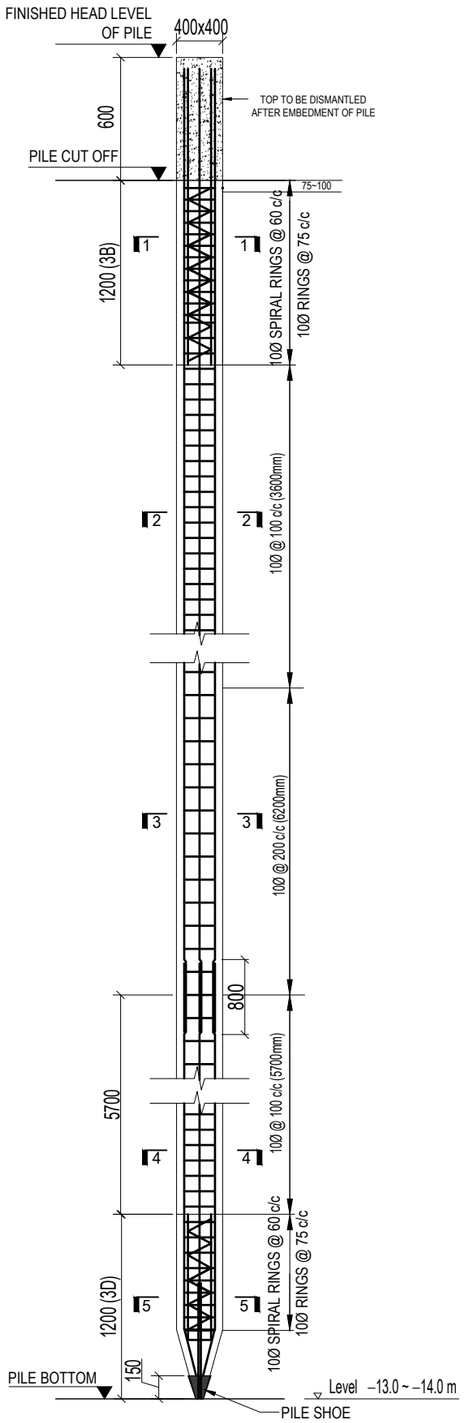


Section at North End

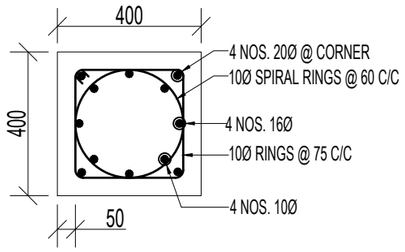
Note: See drg. sheet D-04-A-012 for pile details

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN	**REVISION HISTORY:**	
			SHEET TITLE: Structural Details of Berth	1.	**DATE:** 30-Apr-2025
				2.	**STATUS:**
				3.	**REVISION:** R-00
			CAD BY: **SCALE:** AS SHOWN	**DRG NO.** D-05-A-005	

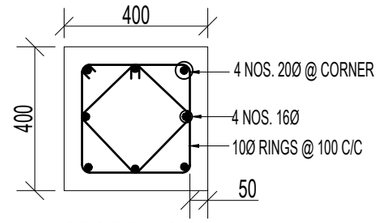
TENDER DRAWINGS



REINFORCEMENT DETAILS OF PILE
Pile length = 18.0m (approx.)



SECTION: 1-1



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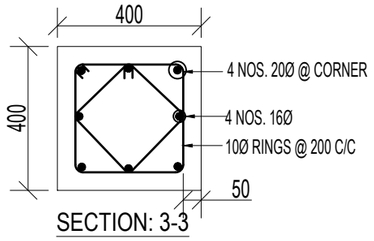
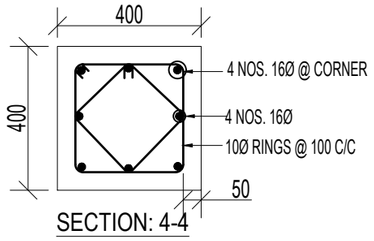
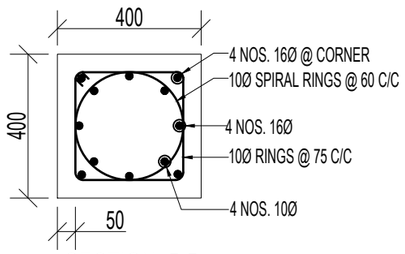


SECTION: 3-3



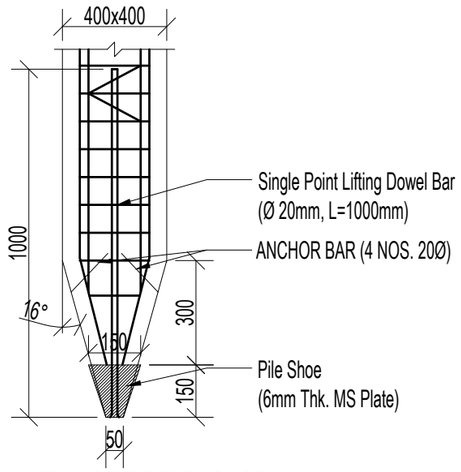
SECTION: 4-4



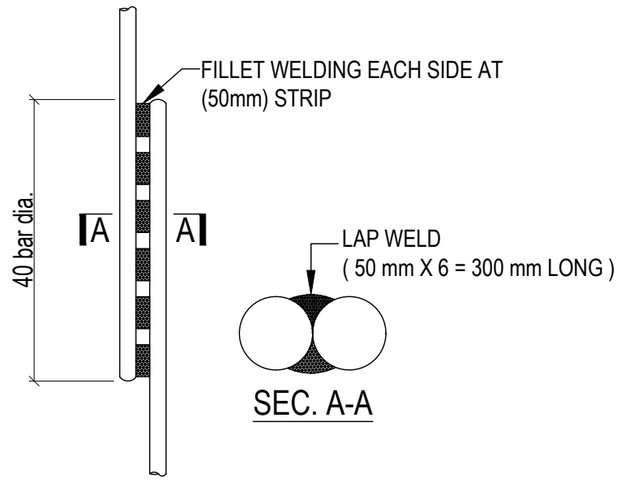
SECTION: 5-5

NOTE FOR PILE :

Allowable compression capacity: 45.0 ton
Allowable uplift capacity: 15.0 ton
Factor of safety: 2.50



DETAILS OF STEEL SHOE



SEC. A-A

LAP DETAIL

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	**OWNER** BANGLADESH NAVY	**CONSULTANT** Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	**DRG. TITLE:** SHIP REPAIR FACILITY DESIGN **SHEET TITLE:** Pile Design Details **CAD BY:** — **SCALE:** AS SHOWN	**REVISION HISTORY:** 1. 2. 3. **DRG NO.** D-05-A-006	**DATE:** 30-Apr-2025 **STATUS:** **REVISION:** R-00

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

DOLPHIN DESIGN

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M.≥ 0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
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Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Dolphin Design Drawings SHEET TITLE: General Notes for Reinforced Concrete Works 1 of 2 CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-06-A-001	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

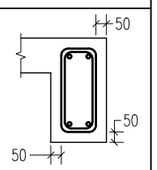
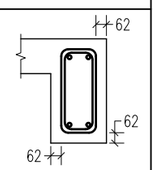
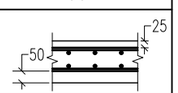
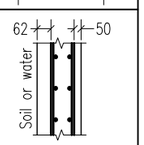
6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

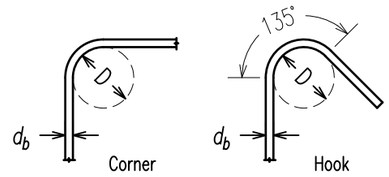
7. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Beam	Top, side & bottom	50mm	
	In contact with soil or water	62mm	
Slab on ground	Top and bottom	25mm and 50mm	
R.C.C wall below ground	In contact with soil or water	62mm	
	Other	50mm	

8. BAR BENDING PIN DIAMETER FOR HOOKS AND L–BENDS

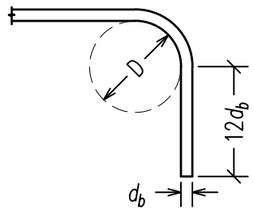
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement



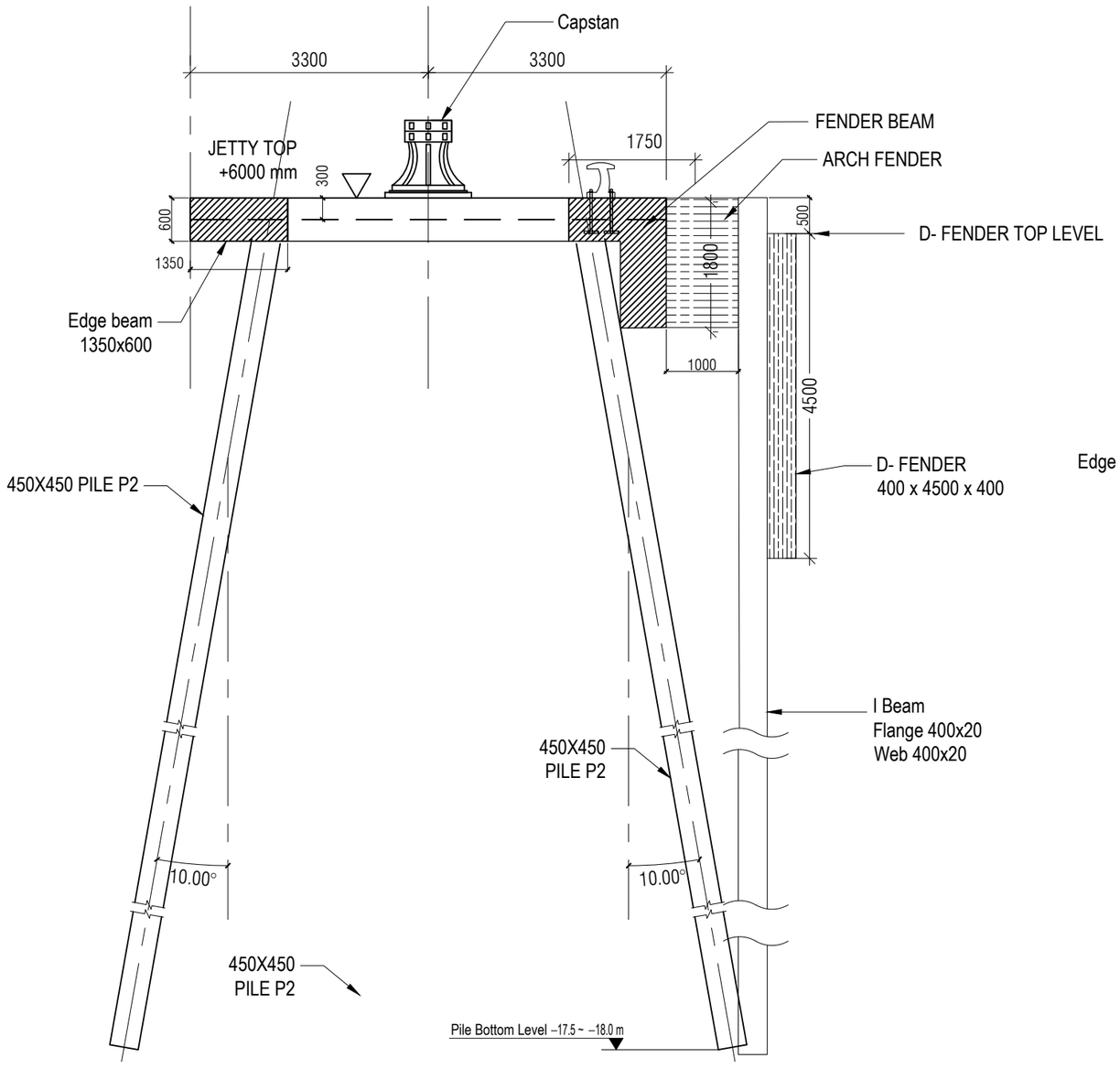
D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

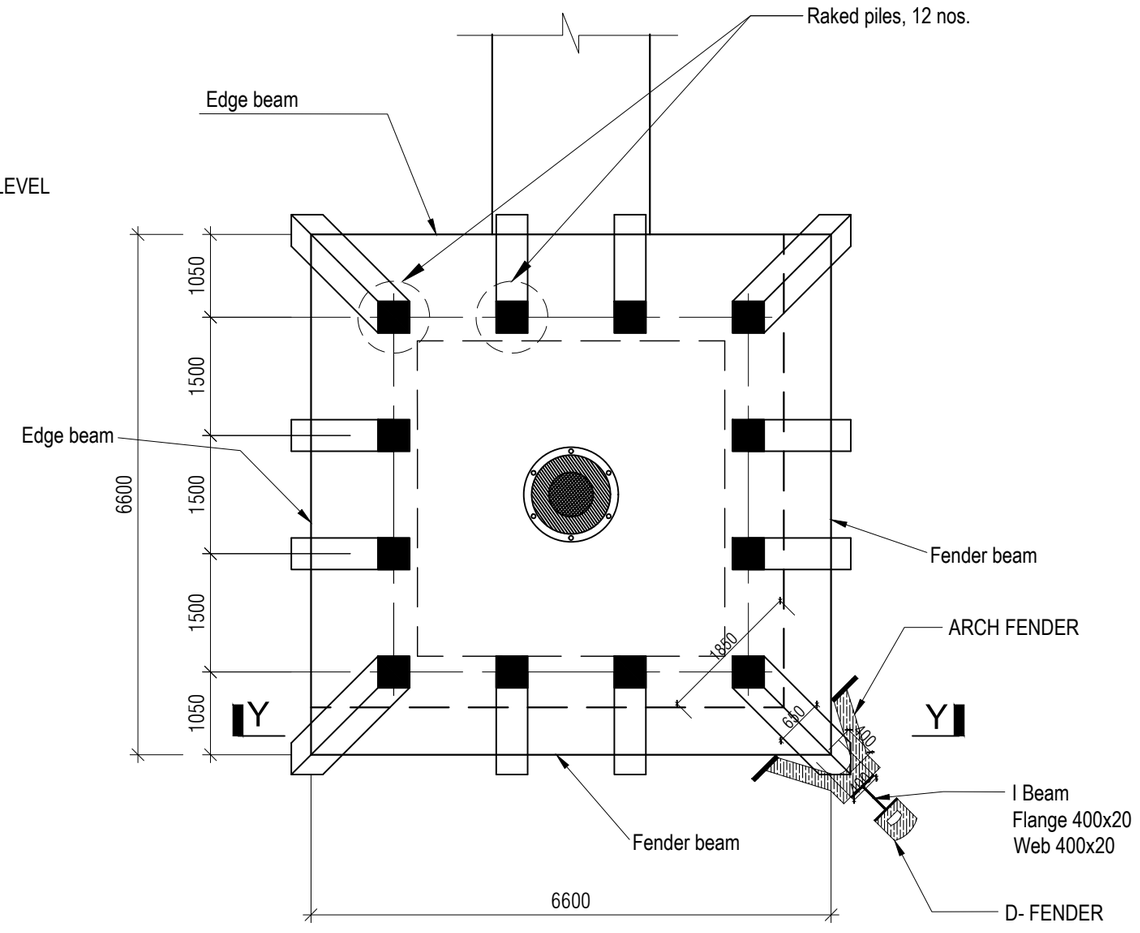
**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Dolphin Design Drawings SHEET TITLE: General Notes for Reinforced Concrete Works 2 of 2 CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-06-A-002

TENDER DRAWINGS



Typical Section of Dolphin with Corner Arch Fender(Y-Y)

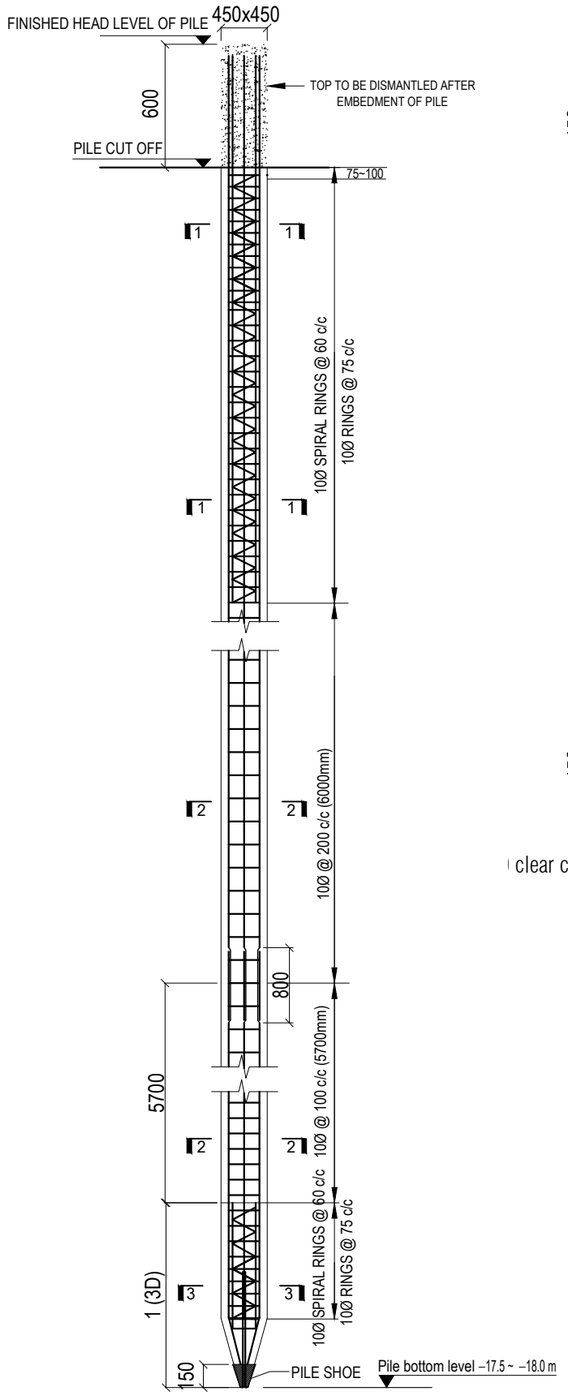


Typical Dolphin Plan with Arch Fender
Other fenders are not shown

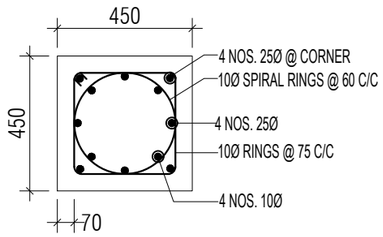
**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Dolphin Design Drawings SHEET TITLE: Typical Plan & Section of Dolphin (Y-Y) CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-06-A-003
				Date: 30-Apr-2025 Status: Revision: R-00

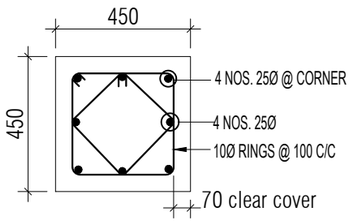
TENDER DRAWINGS



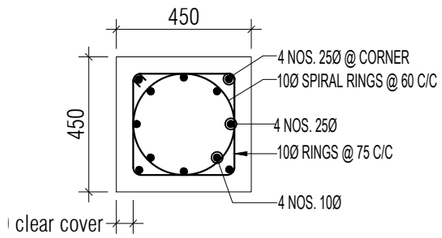
REINFORCEMENT DETAILS OF PILE "P2"



SECTION: 1-1



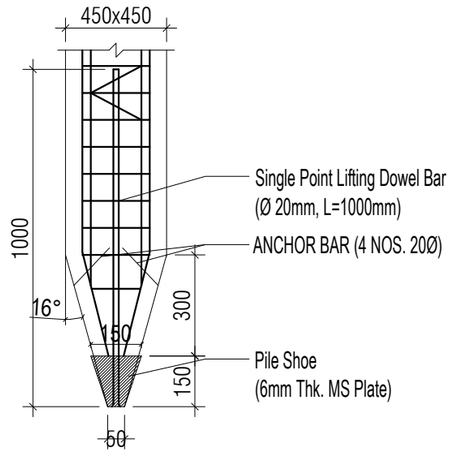
SECTION: 2-2



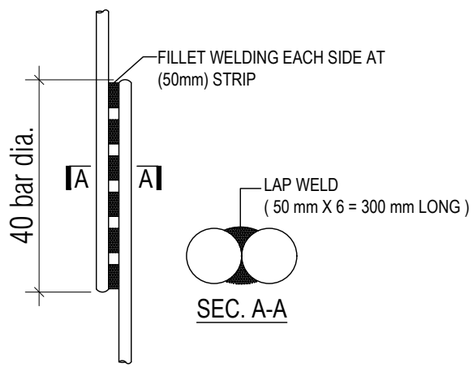
SECTION: 3-3

NOTE FOR PILE :

Allowable compression capacity: 30.0 ton
Allowable uplift capacity: 25.0 ton
Factor of safety: 2.50



DETAILS OF STEEL SHOE



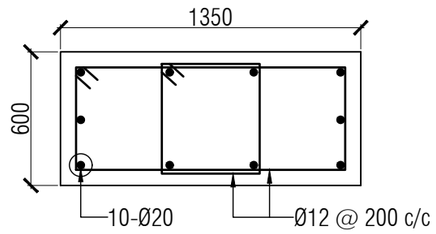
SEC. A-A

LAP DETAIL

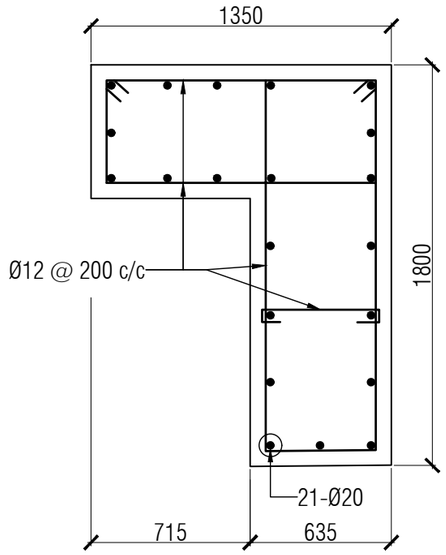
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Dolphin Design Drawings SHEET TITLE: Reinforcement Details of Pile P2 CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-06-A-004
				Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

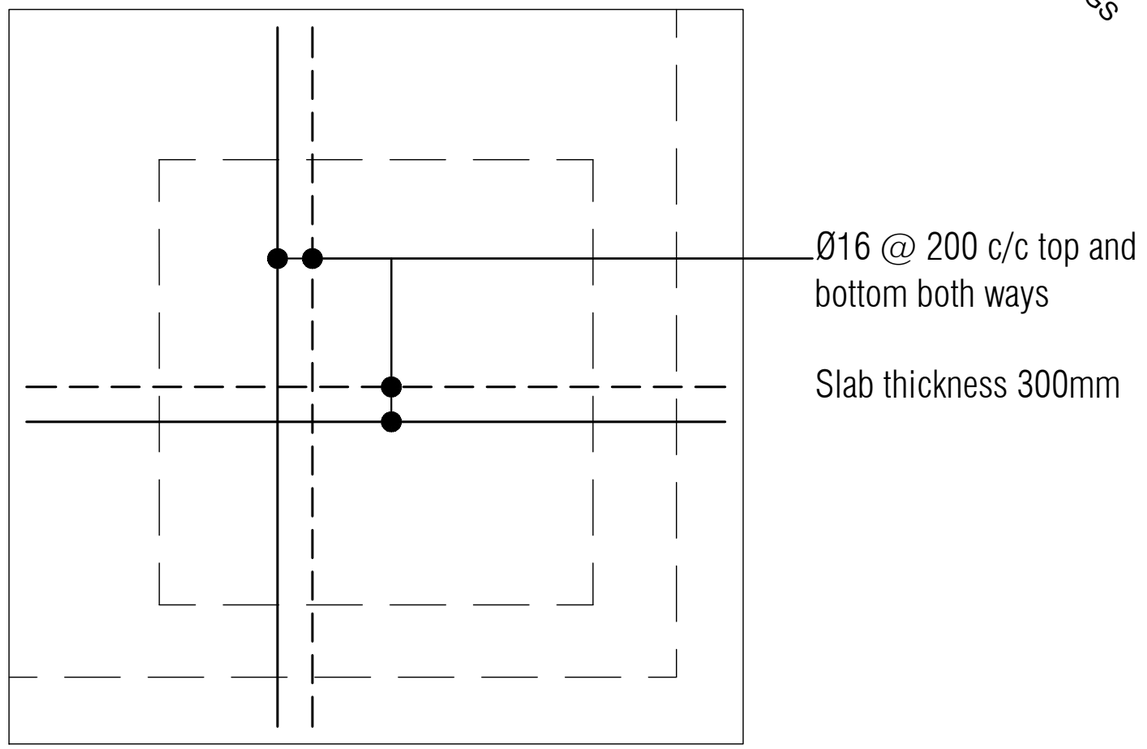


Typical Section of Edge Beam



Typical Section of Fender Beam

Note: Fender beam shall be provided on sides with possible ship impact.
Edge beam shall be provided on the other sides.



Dolphin Slab Reinforcement Details

**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Dolphin Design Drawings SHEET TITLE: Reinforcement Details of Dolphin Jetty Deck Slab and Beams	Revision History: 1. 2. 3.
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-06-A-005
				Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING, PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

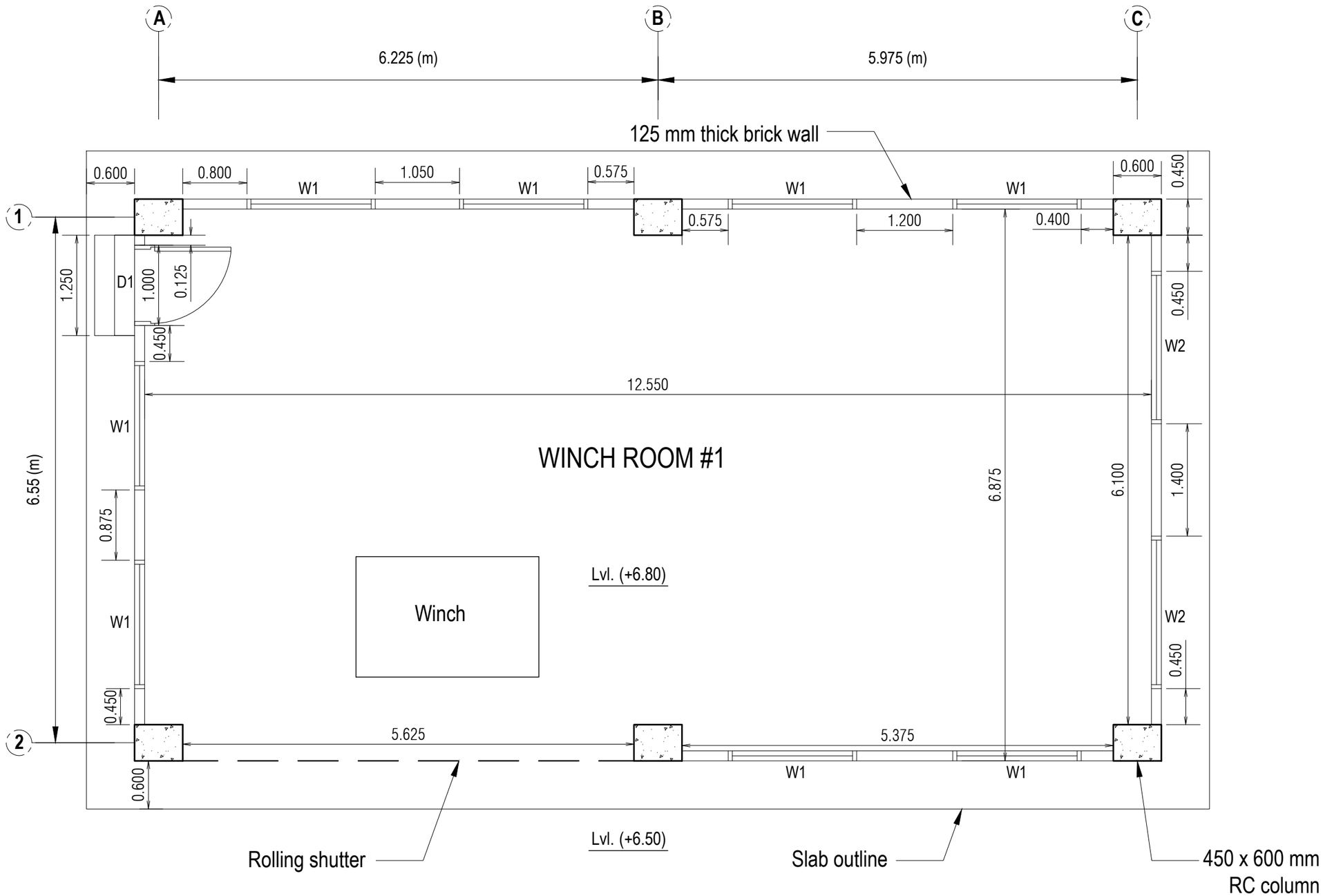
WINCH CONTROL FACILITY

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

TENDER DRAWINGS



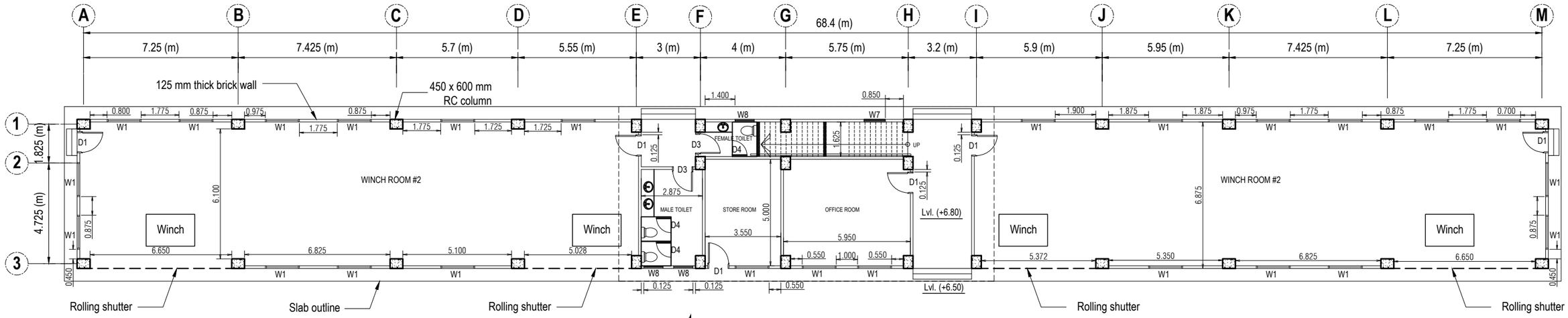
Winch Control Room #1

Ground Floor Plan

Note:
All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility	Revision History:
			SHEET TITLE: Ground Floor Plan of Winch Control Room #1	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-07-A-001

TENDER DRAWINGS

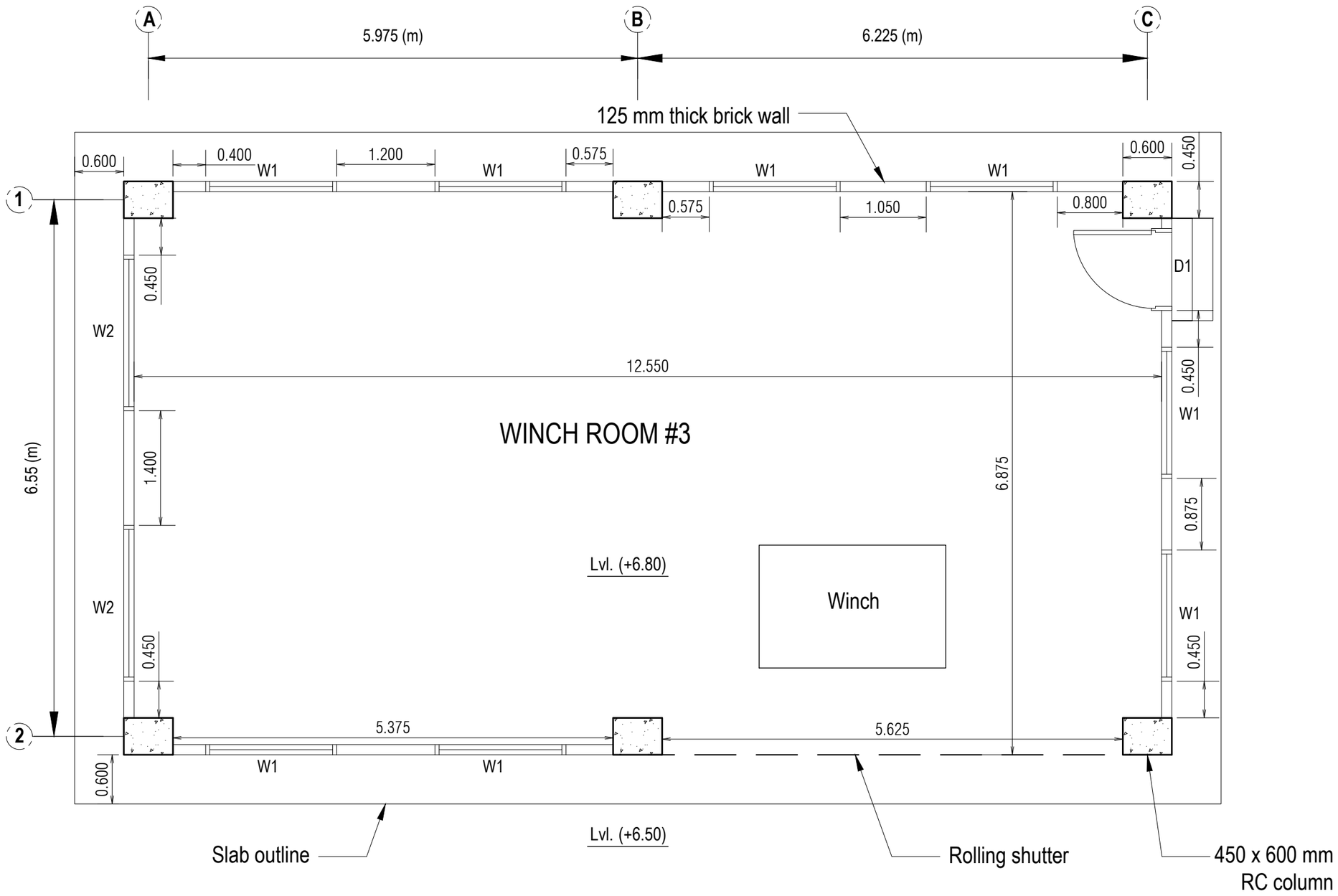


Winch Control Room #2
Ground Floor Plan

Note:
All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility SHEET TITLE: Ground Floor Plan of Winch Control Room #2 CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-A-002	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



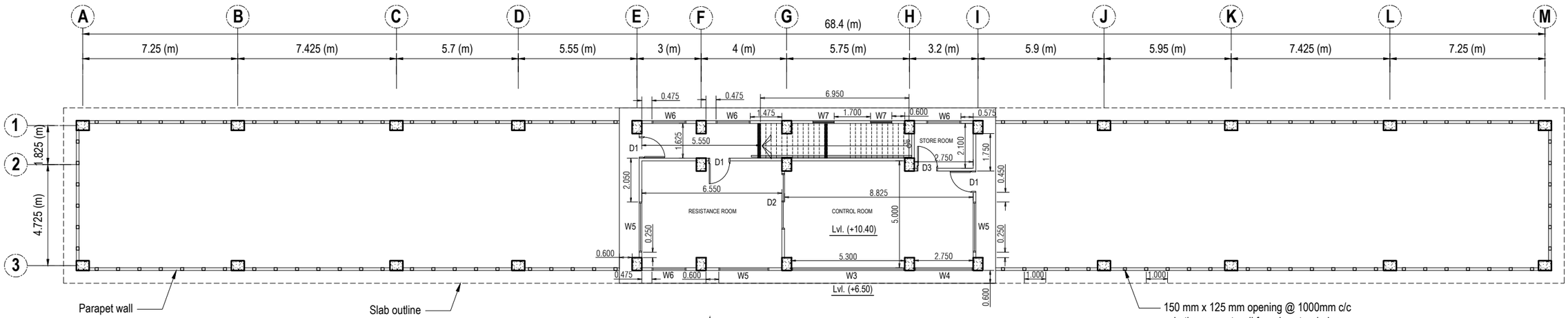
Winch Control Room #3

Ground Floor Plan

Note:
All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility SHEET TITLE: Ground Floor Plan of Winch Control Room #3 CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-A-003	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

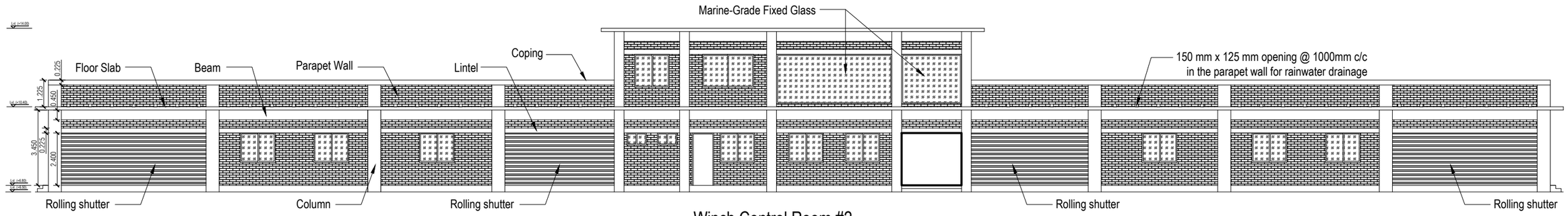


Winch Control Room #2
1st Floor Plan

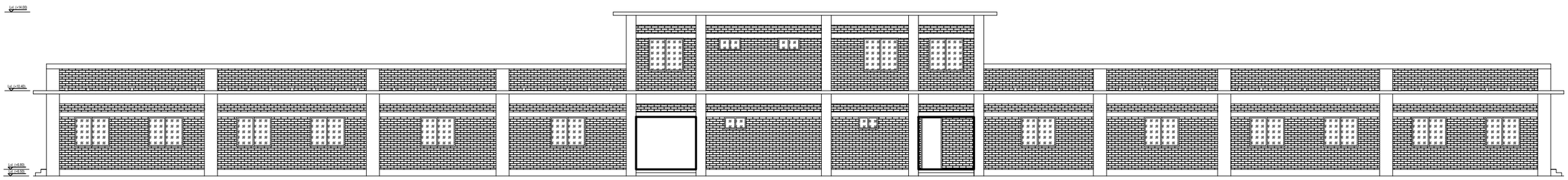
Note:
All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility SHEET TITLE: 1st Floor Plan of Winch Control Room #2 CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-A-004

TENDER DRAWINGS



Winch Control Room #2
West Elevation

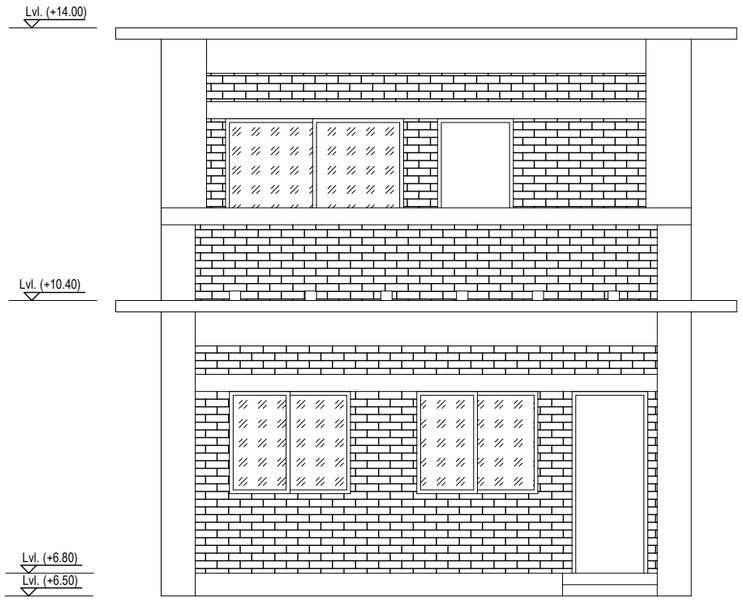


Winch Control Room #2
East Elevation

Note:
All Levels are in Chart Datum

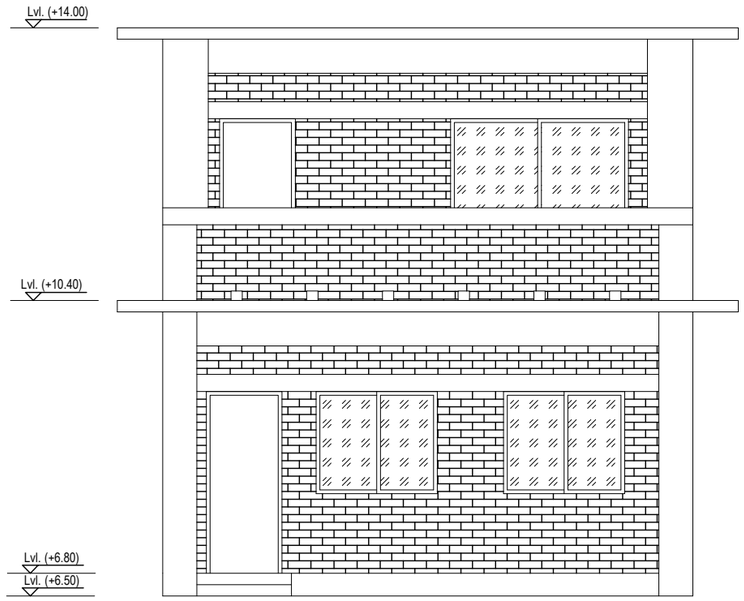
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility		Revision History:
			SHEET TITLE: East and West Elevation of Winch Control Room #2		1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-A-005

TENDER DRAWINGS



Winch Control Room #2

South Elevation



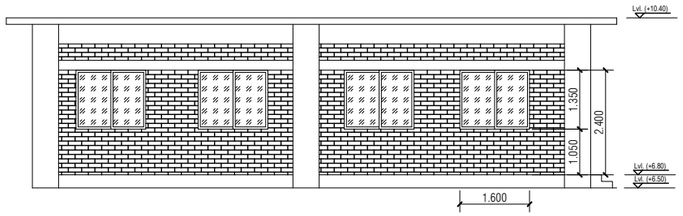
Winch Control Room #2

North Elevation

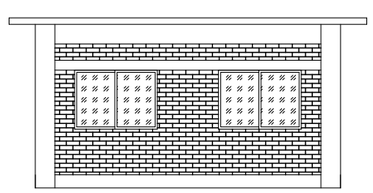
Note:
All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility	Revision History:	
			SHEET TITLE: North and South Elevation of Winch Control Room #2	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-07-A-006	

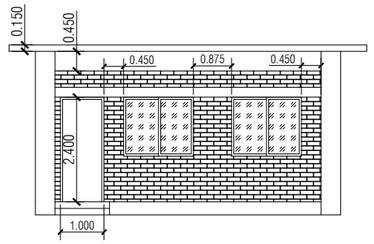
TENDER DRAWINGS



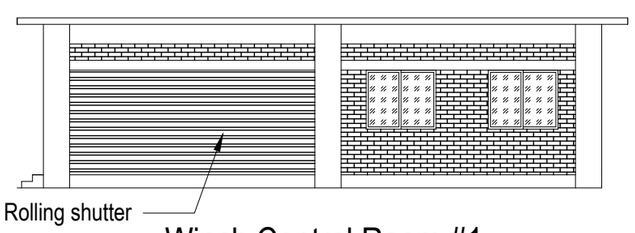
Winch Control Room #1
East Elevation



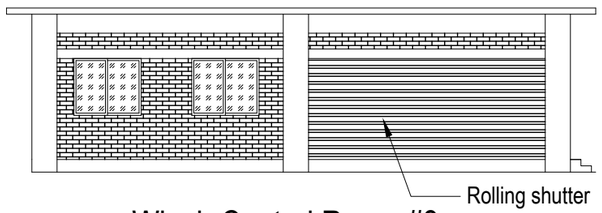
Winch Control Room #1
South Elevation



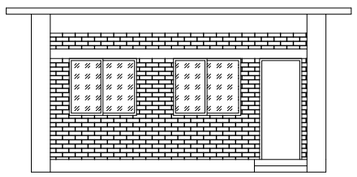
Winch Control Room #1
North Elevation



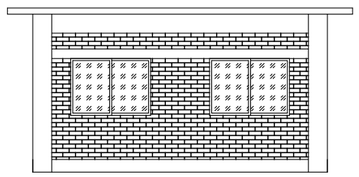
Winch Control Room #1
West Elevation



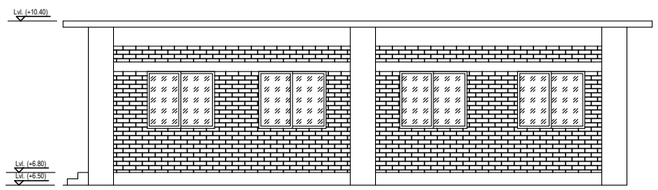
Winch Control Room #3
West Elevation



Winch Control Room #3
South Elevation



Winch Control Room #3
North Elevation



Winch Control Room #3
East Elevation

Note:
All Levels are in Chart Datum.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility SHEET TITLE: Elevation of Winch Control Room #1 and #3 CAD BY: SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-07-A-007

TENDER DRAWINGS

WINDOW SCHEDULE		
TYPE	DESCRIPTION	SIZE (mm)
W1	Glass Panel with Aluminium Frame Sliding Window	1600 X 1350
W2	Glass Panel with Aluminium Frame Sliding Window	1900 X 1350
W3	Glass Panel with Aluminium Frame Fixed Window (Marine-Grade Tempered Glass)	5300 X 2250
W4	Glass Panel with Aluminium Frame Fixed Window (Marine-Grade Tempered Glass)	2750 X 2250
W5	Glass Panel with Aluminium Frame Sliding Window	2350 X 1500
W6	Glass Panel with Aluminium Frame Sliding Window	1600 X 1500
W7	Glass Panel with Aluminium Frame Sliding High Window	1000X 550
W8	Glass Panel with Aluminium Frame Sliding High Window	900 X 550

DOOR SCHEDULE		
TYPE	DESCRIPTION	SIZE (mm)
D1	Single Panel Flash Swing Door	1000 X 2400
D2	Glass Panel with Aluminium Frame Sliding Door	2600 X 2400
D3	Single Panel uPVC Swing Door	960 X 2400
D4	Single Panel HPL Compact Board Swing Door	700 X 1800

Note:
All Levels are in Chart Datum.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Design of the Winch Control Facility	Revision History:	
			SHEET TITLE: Window and Door Schedule	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-07-A-008	

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M≥0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: General Note 1 of 5	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-001

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

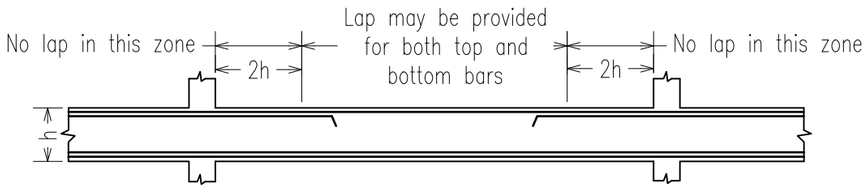
Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

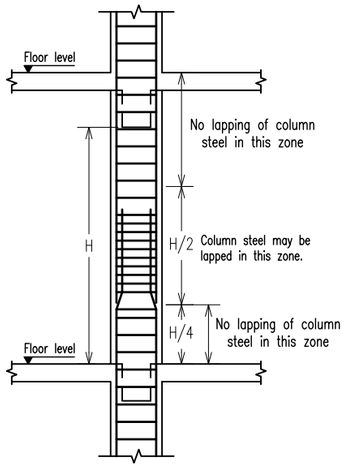
Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

7. LAP SPLICE LOCATION IN BEAMS



Not more than 50% of the bars shall be spliced at one place of the beam. Lap splices are to be confined by hoops/stirrups with maximum spacing of 100mm.

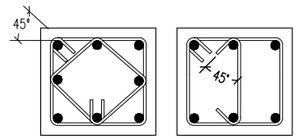
8. LAP SPLICE LOCATION IN COLUMNS



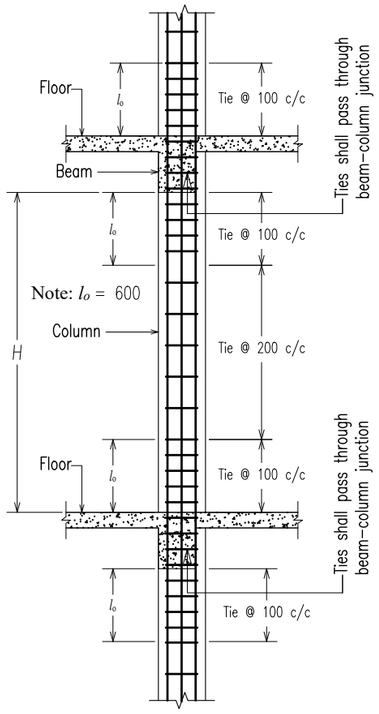
Lap splices are to be confined by hoops/ties with maximum spacing of 125mm.

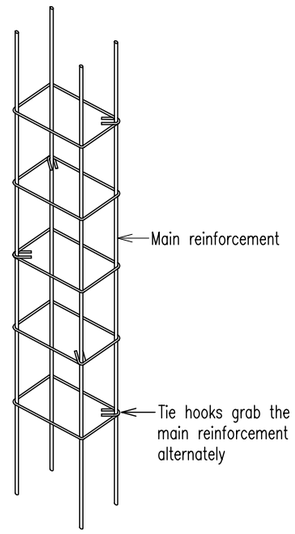
9. COLUMN TIE DETAILS

a. Hook's of column ties:
Hooks of column ties shall be bent 45° inwards and length of the hook shall be minimum 75mm as shown below. Ties shall be arranged such that corner hooks grab the main reinforcement in alternate fashion. Tie spacing shall be in accordance with that shown in fig below.



b. Spacing of column ties in buildings:
Spacing of column ties shall be as shown in fig below.





Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility		Revision History:
			SHEET TITLE: General Note 2 of 5		1.
					2.
					3.
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-002

Revision History: | Date: 30-Apr-2025 | Status: | Revision: R-00

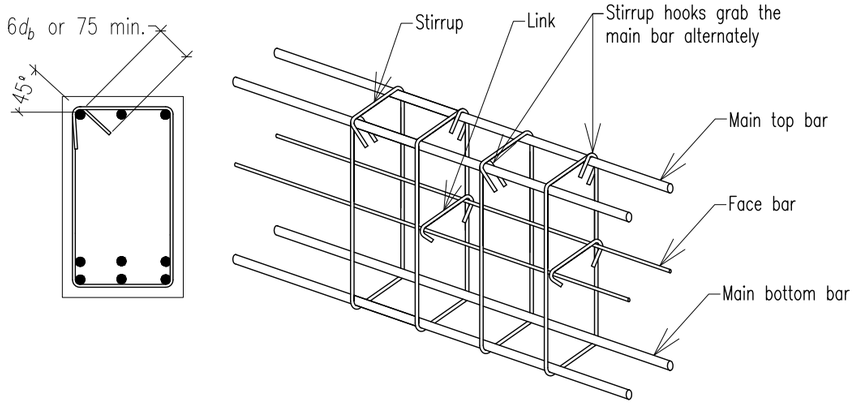
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

10. BEAM STIRRUP

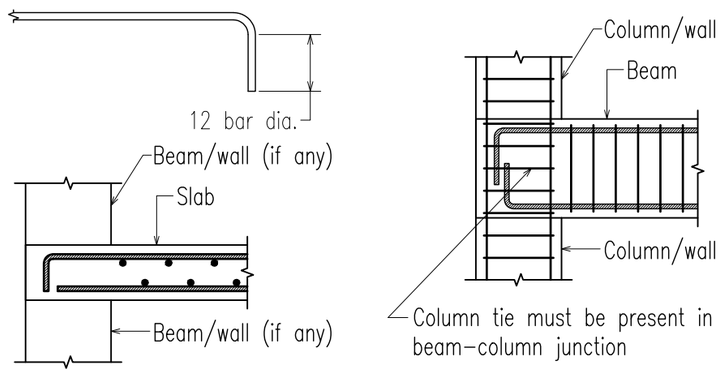
Hooks in beam stirrups shall be bent 45° inwards and length of the hook shall be minimum 3" (75mm) as shown below. Stirrups shall be arranged such that corner hooks grab the main reinforcement in alternate fashion.



11. END ANCHORAGE FOR HORIZONTAL REINFORCEMENT (IN BEAM, SLAB, MAT ETC).

90° hooks shall be provided for i) all main bars of beams (top and bottom) which terminate into column or walls or other beams. ii) slab top bars terminating into supporting beams or walls. iii) mat reinforcement terminating at the periphery.

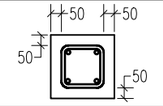
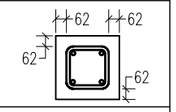
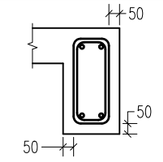
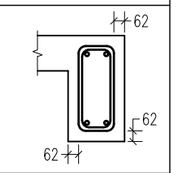
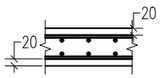
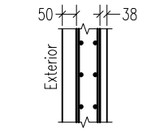
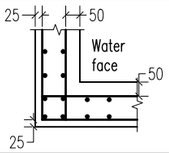
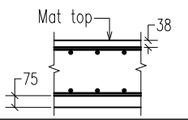
For all cases, the length of the hook shall be 12 times the bar diameter ($12d_b$).



Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

12. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Column, lift core and shear wall	Above ground level	50mm	
	Below or in contact with ground	62mm	
Beam	Top, side & bottom	50mm	
	Water face inside water tank side & bottom, below or in contact with ground	62mm	
Slab and stair	Top and bottom	20mm	
R.C.C wall below ground	Exterior	50mm	
	Interior	38mm	
Water tank	Water face	50mm	
	Other face	25mm	
Footing and Mat foundation	Top	38mm	
	Bottom	75mm	

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: General Note 3 of 5 CAD BY: / SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00
Drg No. D-07-B-003		

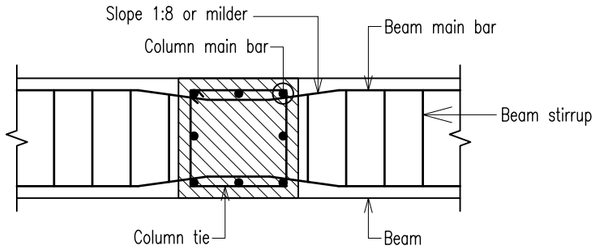
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

13. AVOIDING CONFLICT BETWEEN BEAM AND COLUMN REINFORCEMENT

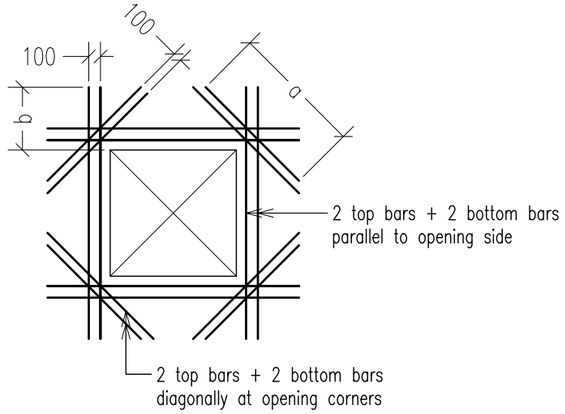
If conflict arises between beam and column or wall reinforcement when beam steel enters or passes through column, the beam reinforcement may be horizontally bent inwards into the column as shown in the following figure.



PLAN SECTION OF BEAM COLUMN JOINT

14. REINFORCEMENT DETAILING AROUND VOID/OPENING

Reinforcement details around void/opening in floor slabs shall be as shown in figure below. The detailing is valid for maximum void size of 900x900. For void/opening of larger size contact the consultant.

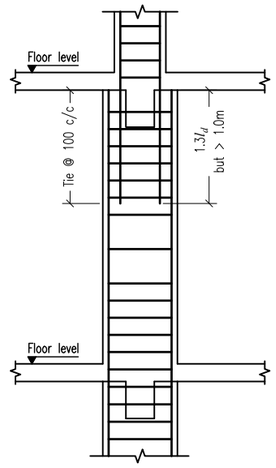


	Void/opening size less than 450	Void/opening size between 450 ~ 900
Dim. a	900	1500
Dim. b	600	900
Bar size	ø16	ø20

Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

15. COLUMN OFFSET DETAIL

When column size is reduced the transition of column main reinforcement from lower floor to upper floor shall be detailed as shown below.

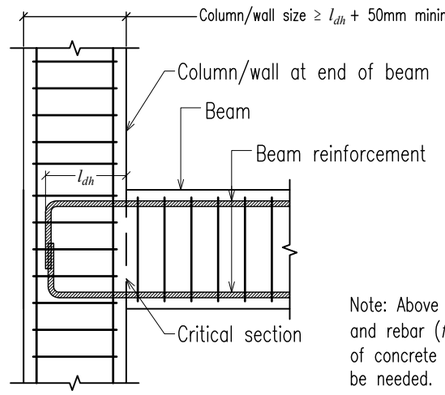


16. BRICK WORK

All brick work shall use first class brick or as specified by the consultant. Morter for brick work shall constitute 1:4 mix ratio (cement:sand). Morter for plastering work shall be 1:4 mix ratio (cement:sand).

17. END ANCHORAGE OF BEAM REINFORCEMENT

Minimum end anchorage length l_{dh} as shown below for different bar sizes must be maintained throughout.



fc' = 35 MPa, fy = 500 MPa	
Bar dia.	l_{dh}
mm	mm
10	150
12	150
16	225
20	300
25	425

Note: Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of embedment length shall be needed.

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: General Note 4 of 5 CAD BY: / SCALE: AS SHOWN
			Revision History: 1. 2. 3. Drg No. D-07-B-004
			Date: 30-Apr-2025 Status: Revision: R-00

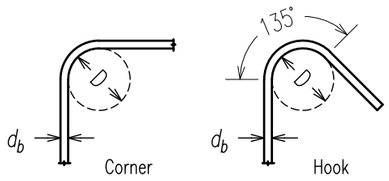
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

18. BAR BENDING PIN DIAMETER FOR HOOKS AND L-BENDS

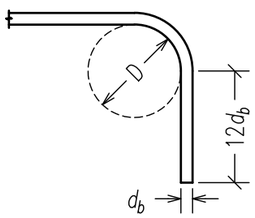
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement

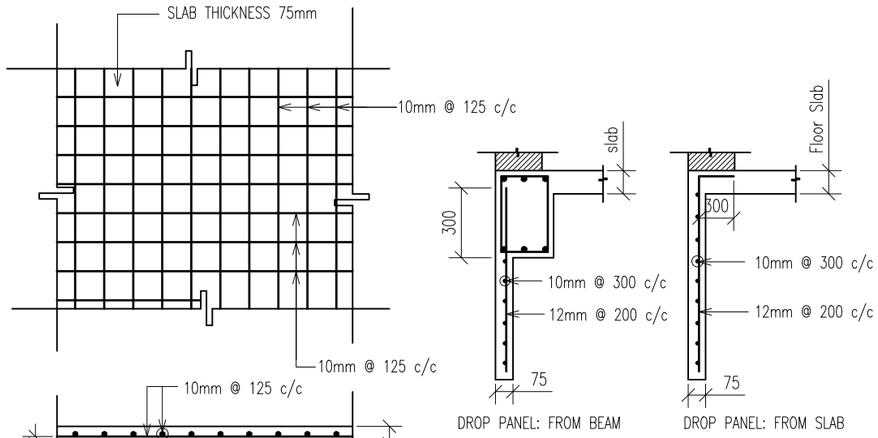


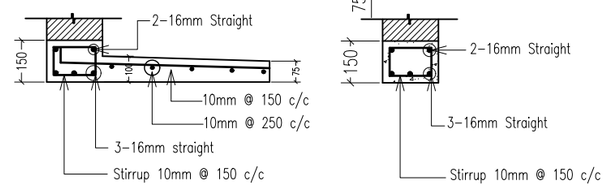
D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

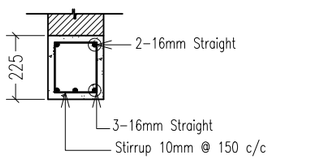
Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

19. MISCELLANEOUS STRUCTURAL DETAILS

The miscellaneous details shown below shall be followed wherever applicable unless otherwise mentioned elsewhere.





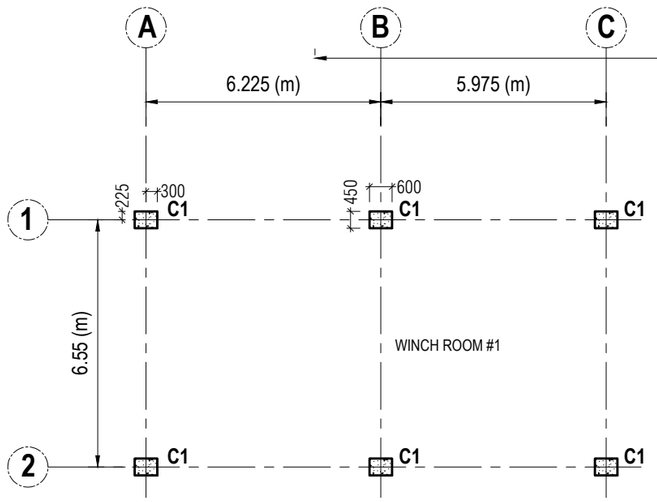


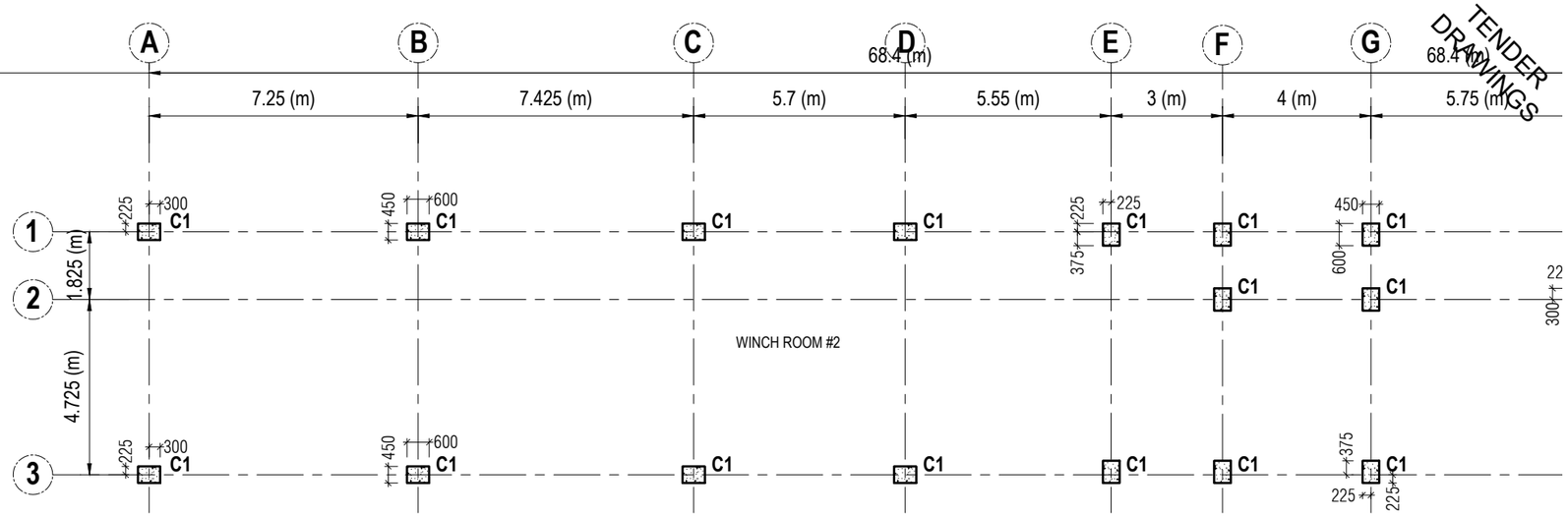
Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility	Revision History:
			SHEET TITLE: General Note 5 of 5	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-07-B-005

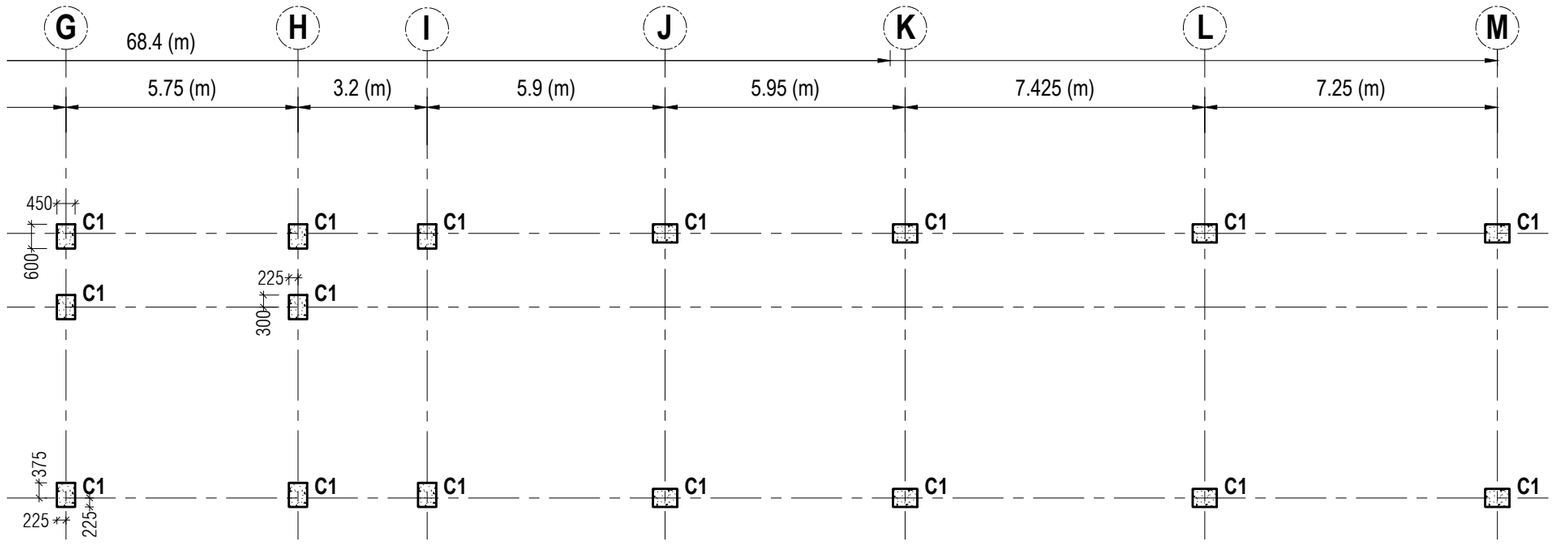
TENDER DRAWINGS

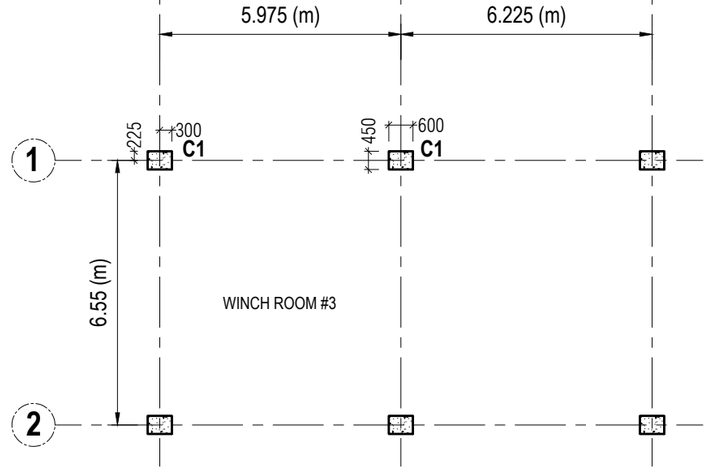




Winch Control Room #1
Column Layout Plan

Winch Control Room #2
Column Layout Plan





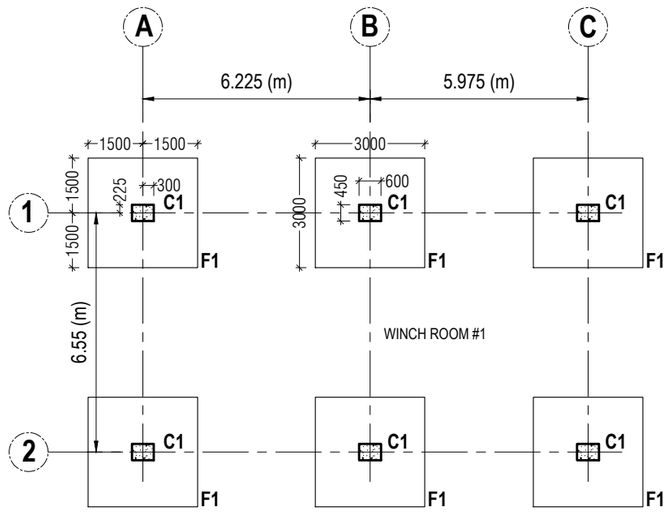
m #2

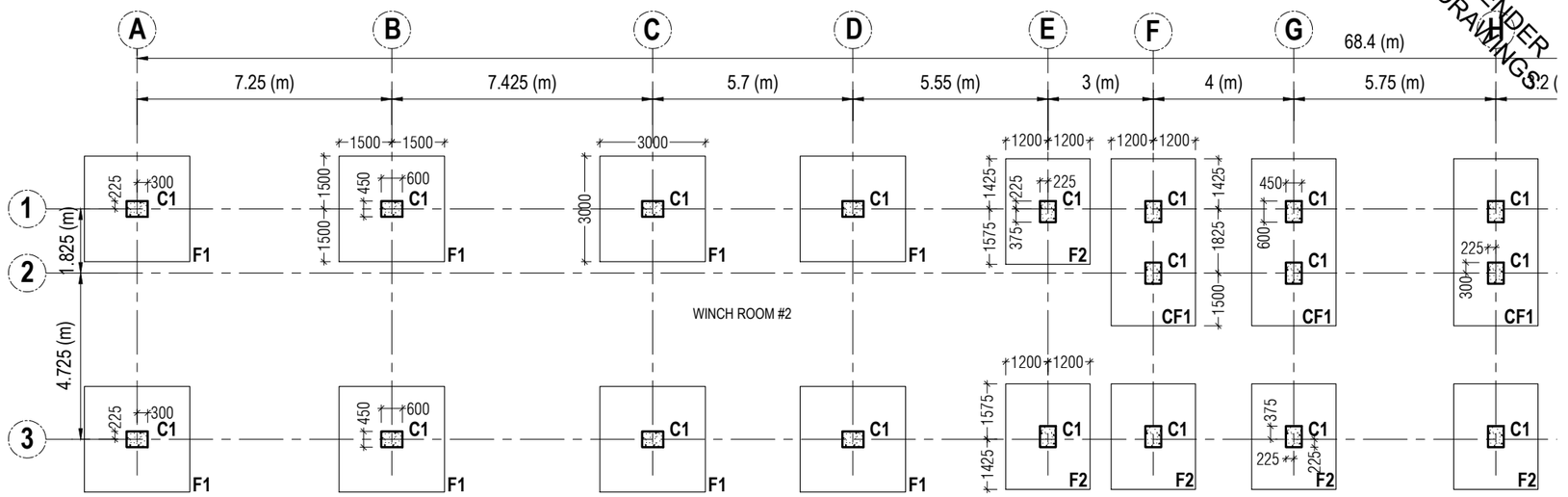
Winch Control Room #3
Column Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Column Layout Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-006	Date: 30-Apr-2025 Status: Revision: R-00

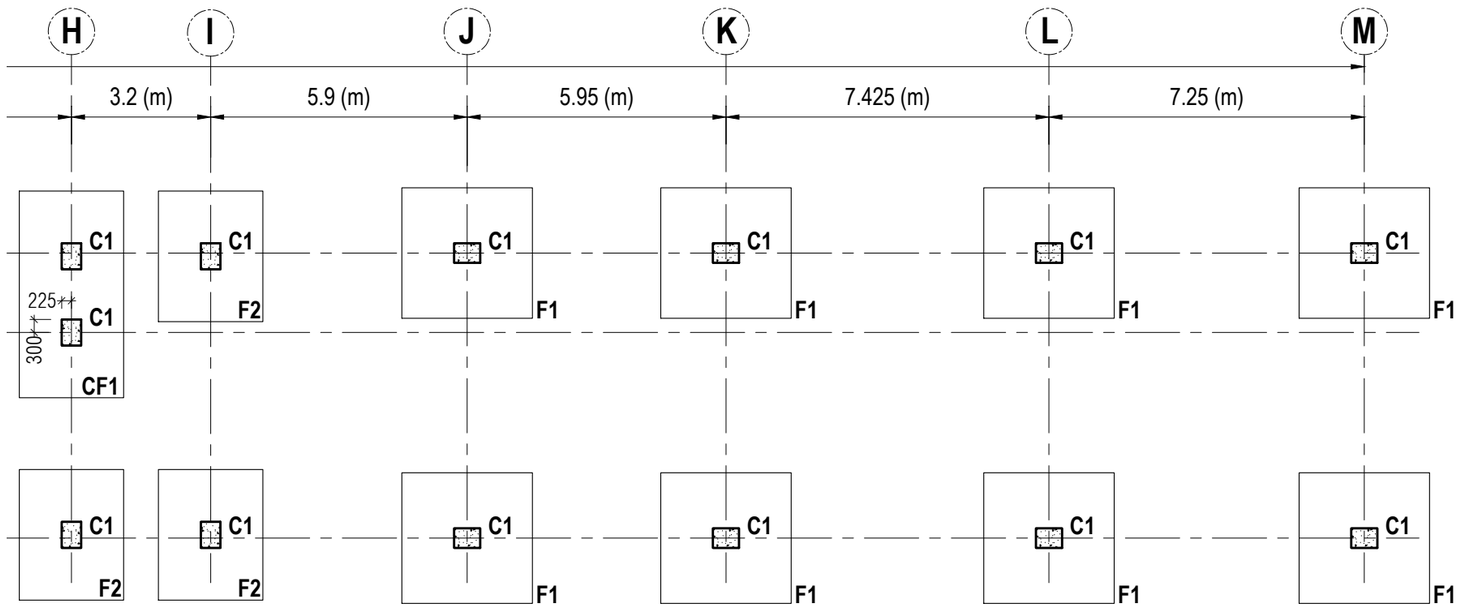
TENDER DRAWINGS

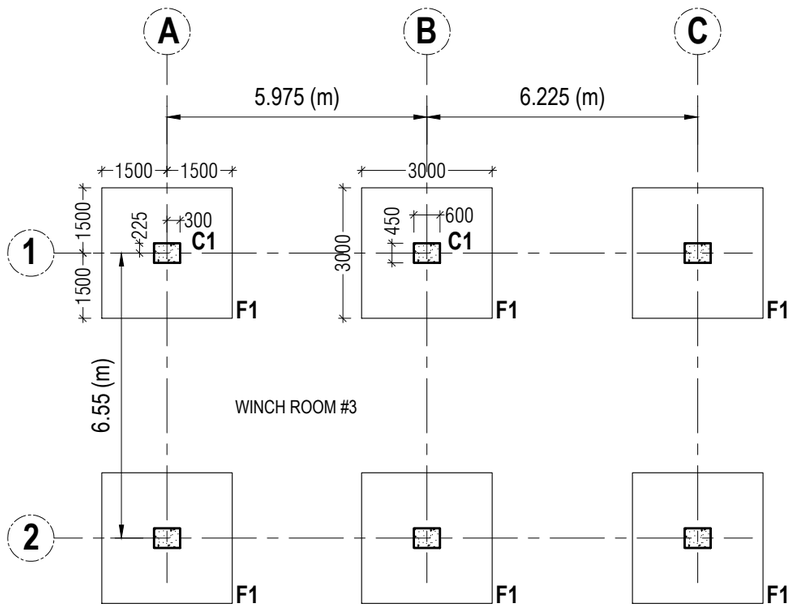




Winch Control Room #1
Footing Layout Plan

Winch Control Room #2
Footing Layout Plan





Winch Control Room #3
Footing Layout Plan

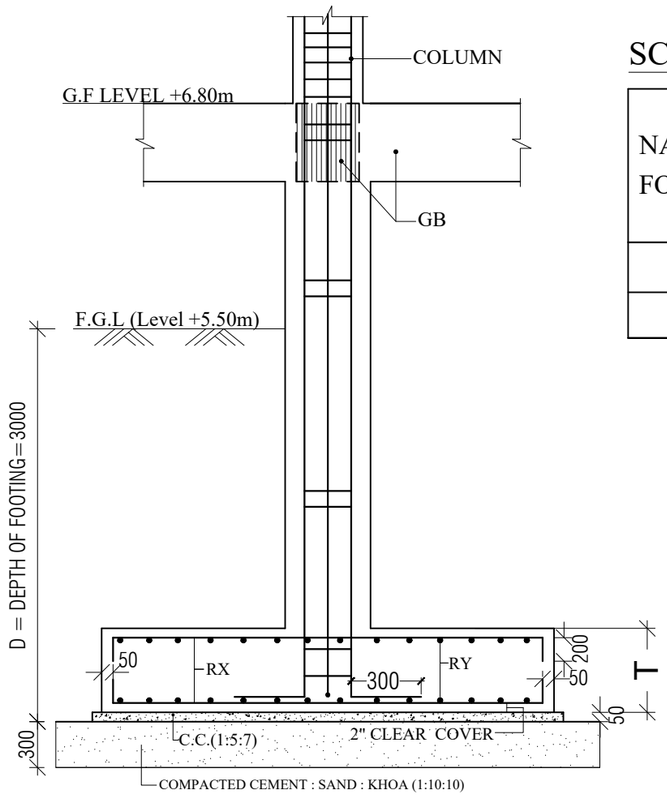
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Foundation Layout Plan CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-B-007

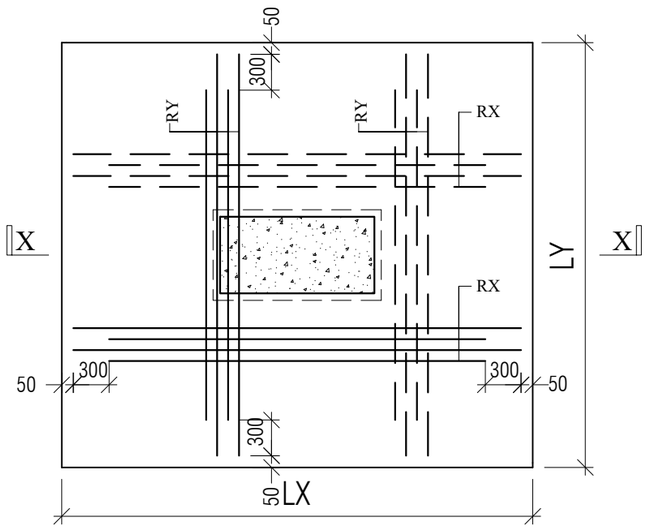
TENDER DRAWINGS

SCHEDULE OF FOOTING :

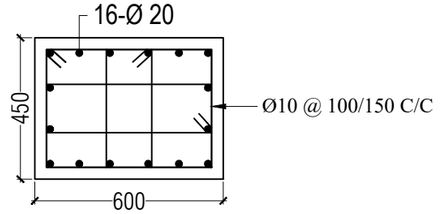
NAME OF FOOTING	SIZE OF FOOTING		THICKNESS OF FOOTING	REINF. OF FOOTING.	
	LX	LY	T mm	Rx	Ry
F1	3000	3000	900	Ø20 @ 150 C/C	Ø20 @ 150 C/C
F2	3000	2400	900	Ø20 @ 125 C/C	Ø20 @ 125 C/C



SECTION ON - X-X



PLAN OF TYPICAL FOOTING

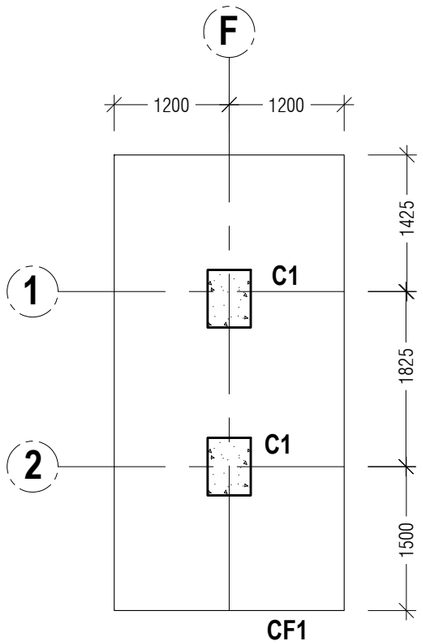


Column Section - C1

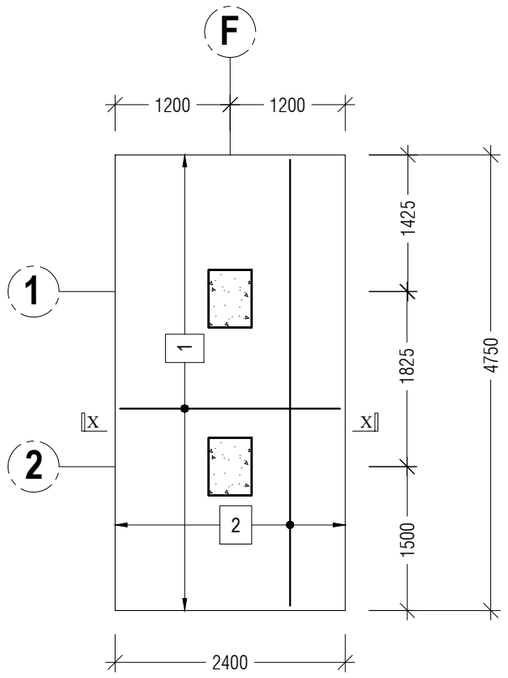
**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility	Revision History:	
			SHEET TITLE: Reinforcement Details of Column and Individual Footing	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-008

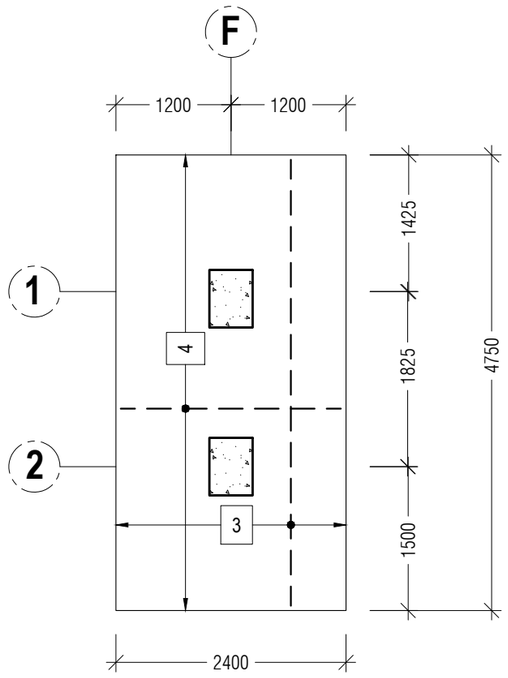
TENDER DRAWINGS



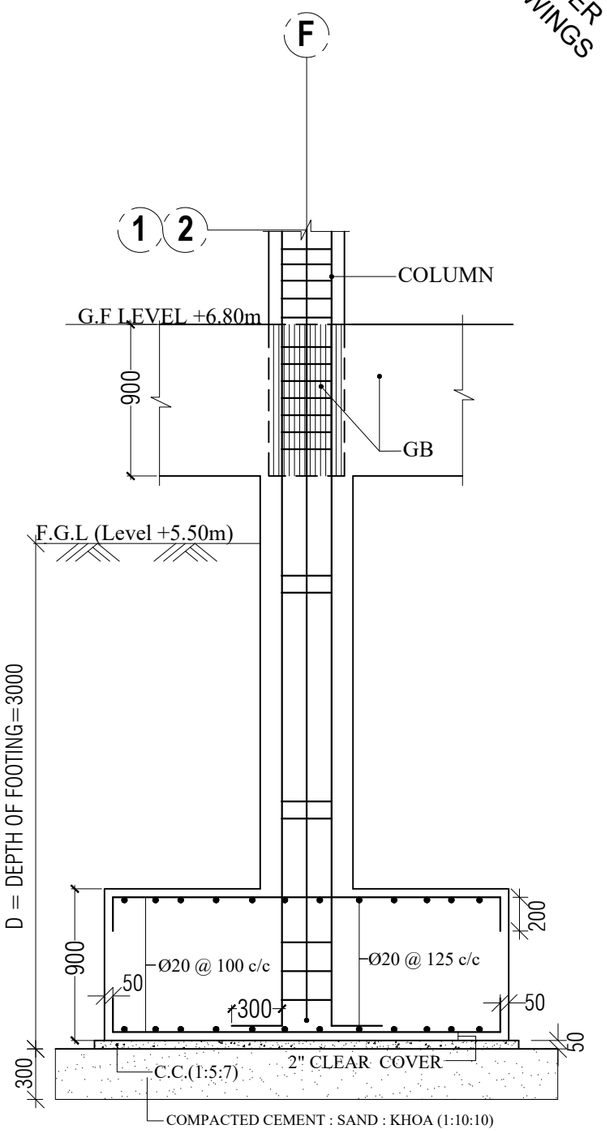
Footing Geometry of Combined Footing #1 (CF1)



Bottom Reinforcement of Combined Footing #1 (CF1)



Top Reinforcement of Combined Footing #1 (CF1)



SECTION ON - X-X

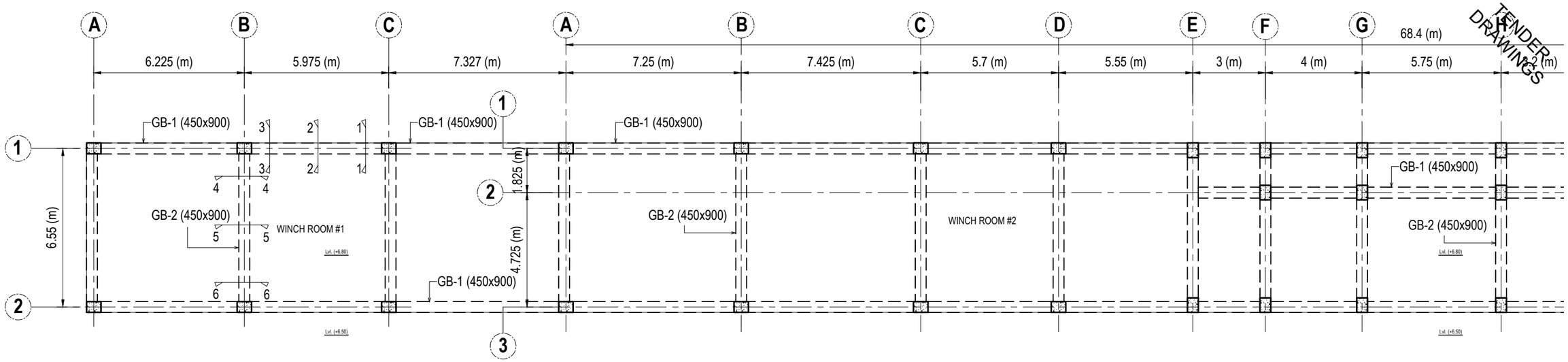
LEGEND:

1. 20Ø @ 100 c/c bottom
2. 20Ø @ 125 c/c bottom
3. 20Ø @ 125 c/c top
4. 20Ø @ 100 c/c top

Thickness = 900

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility	Revision History:
			SHEET TITLE: Reinforcement Details of Combined Footing	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-07-B-009

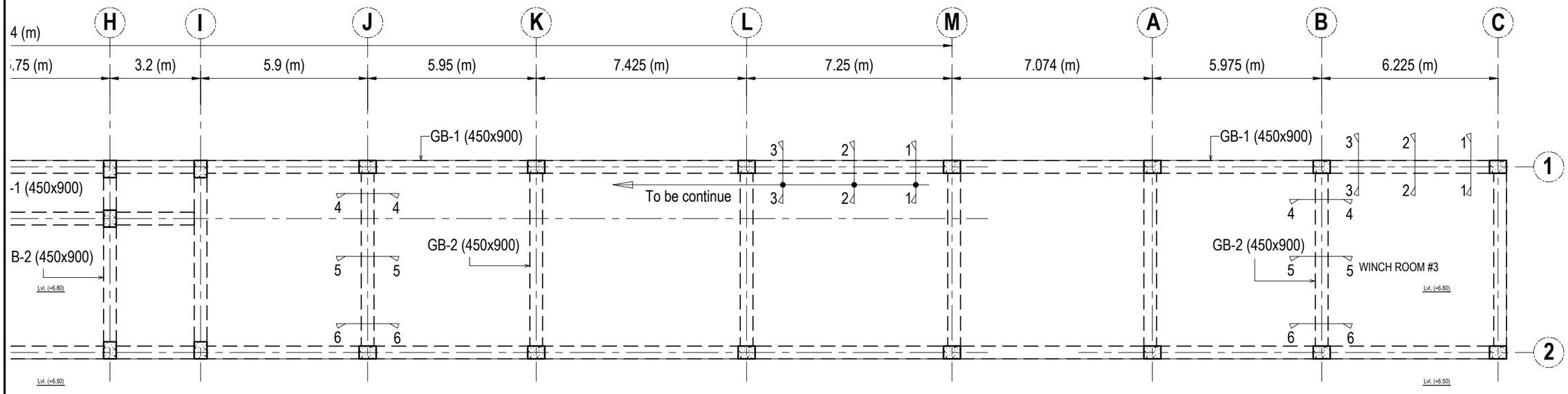


N

Winch Control Room #1
Grade Beam Layout Plan (Level +6.80 m)

N

Winch Control Room #2
Grade Beam Layout Plan (Level +6.80 m)



oom #2
an (Level +6.80 m)

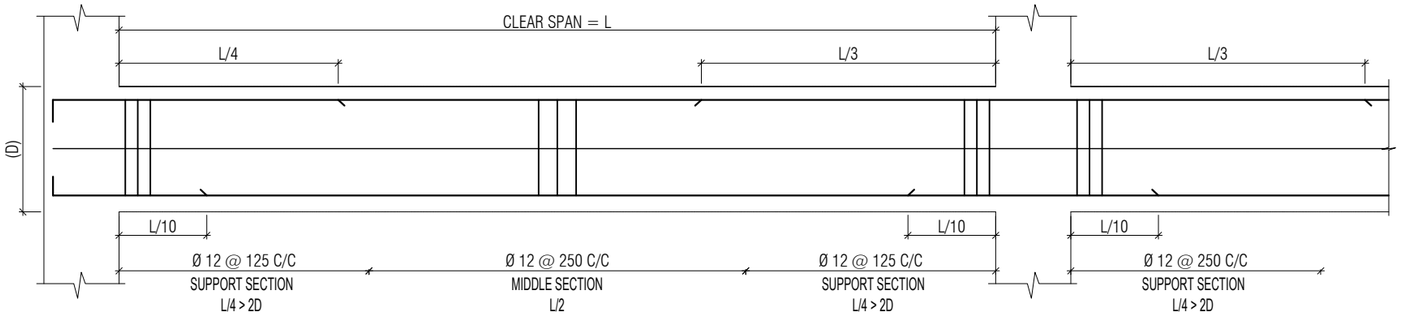
N

Winch Control Room #3
Grade Beam Layout Plan (Level +6.80 m)

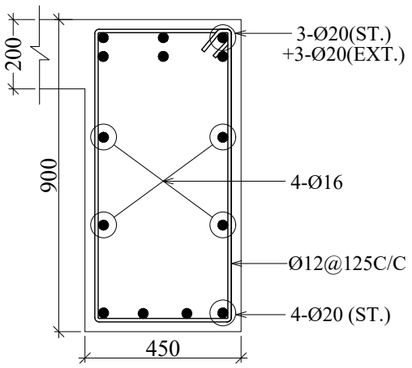
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Ground Floor Beam & Column Layout Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-010	Date: 30-Apr-2025 Status: Revision: R-00

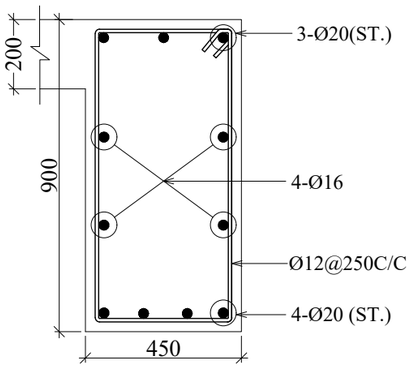
TENDER DRAWINGS



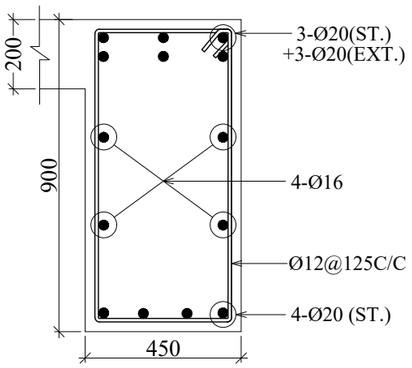
TYPICAL LONG SECTION OF GRADE BEAM, GB



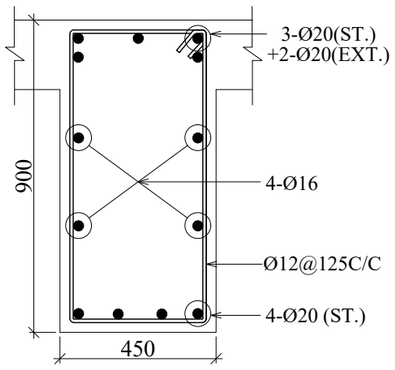
SEC. 1-1



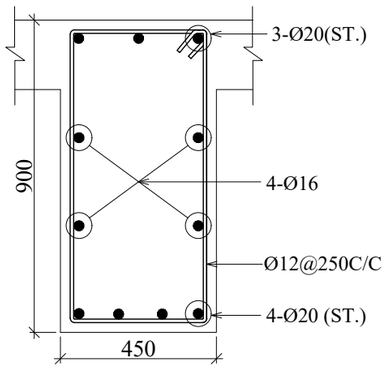
SEC. 2-2



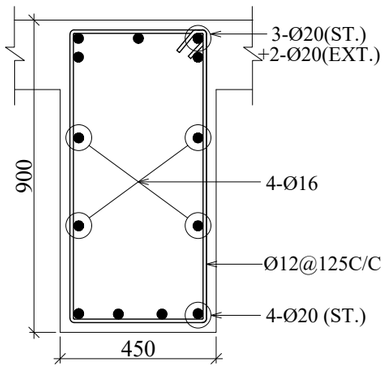
SEC. 3-3



SEC. 4-4



SEC. 5-5

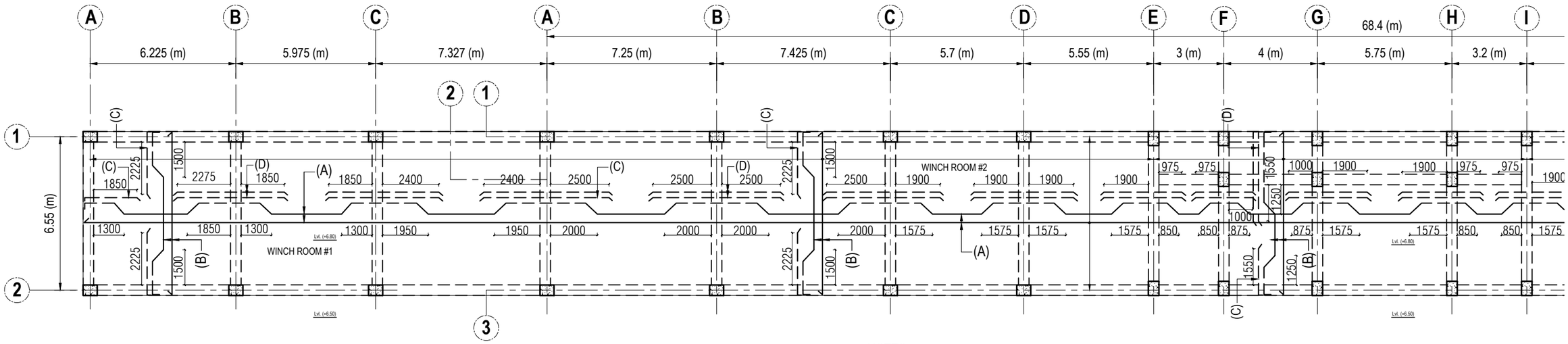


SEC. 6-6

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility		Revision History:	
			SHEET TITLE: Details of Grade Beam Reinforcement		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-011	

TENDER DRAWINGS



Winch Control Room #1
Ground Floor Slab Reinforcement Details
(Level +6.80 m)

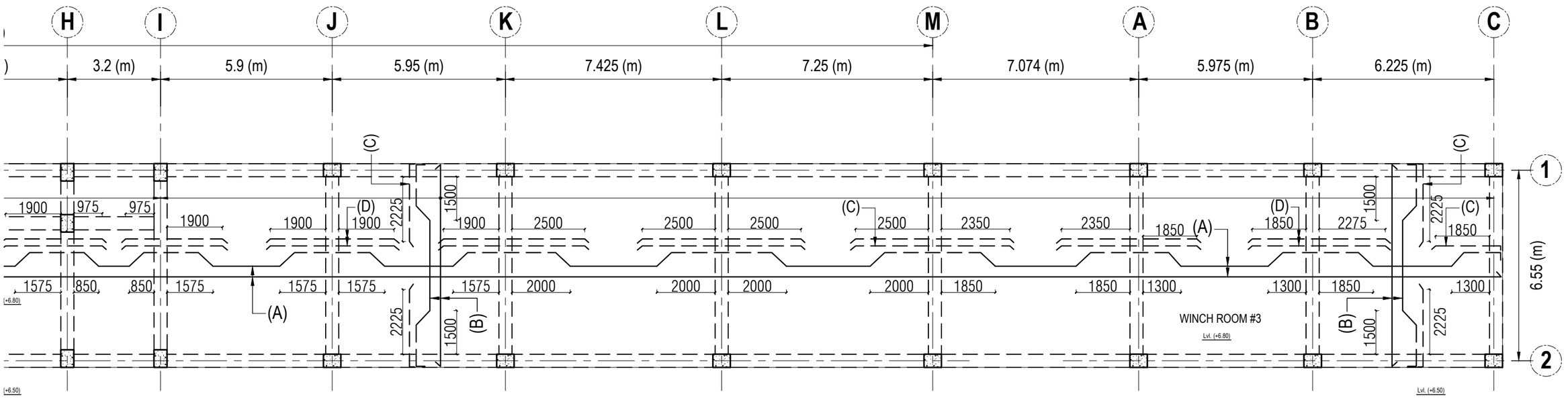
NOTES:
1. SLAB THICKNESS IS = 200
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 125 C/C ALT CKD.
   B = Ø12 @ 125 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 125 C/C

Winch Control Room #2
Ground Floor Slab Reinforcement Details
(Level +6.80 m)

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Ground Floor Slab Reinforcement Details and Grade Beam Layout 1 of 2 CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-B-012

TENDER DRAWINGS



NOTES:

1. SLAB THICKNESS IS = 200
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 125 C/C ALT CKD.
   B = Ø12 @ 125 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 125 C/C

Winch Control Room #2

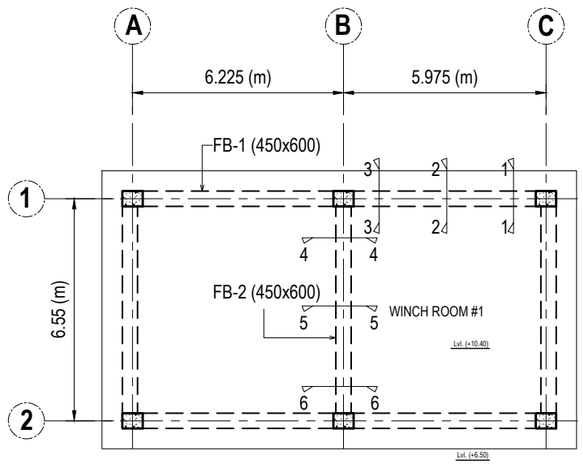
Ground Floor Slab Reinforcement Details
(Level +6.80 m)

Winch Control Room #3

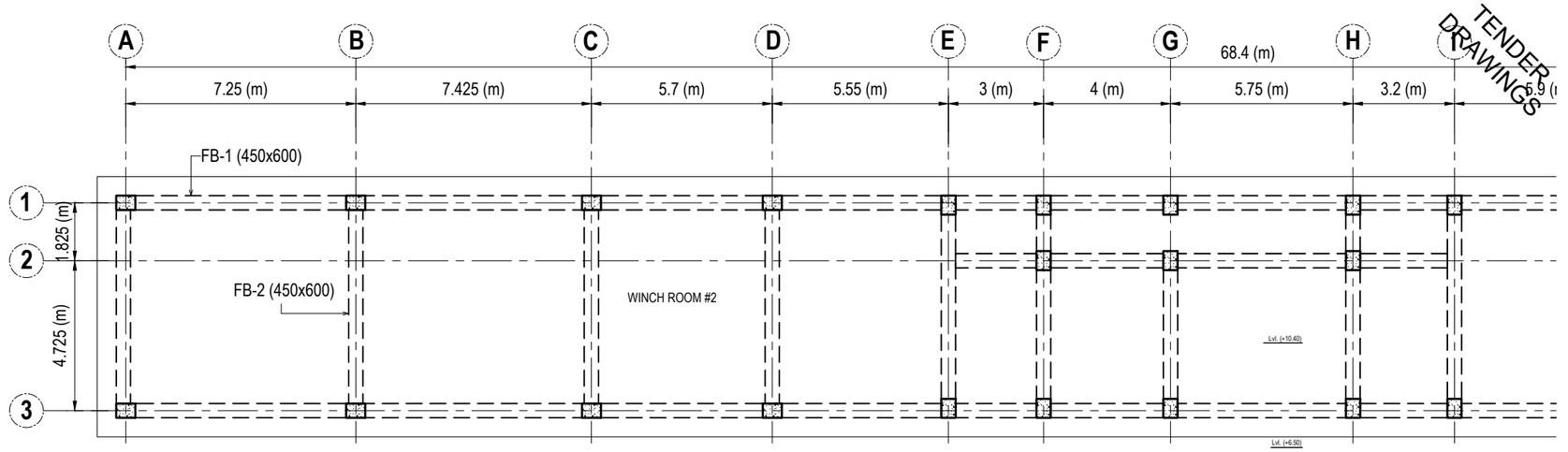
Ground Floor Slab Reinforcement Details
(Level +6.80 m)

**All Levels are in Chart Datum

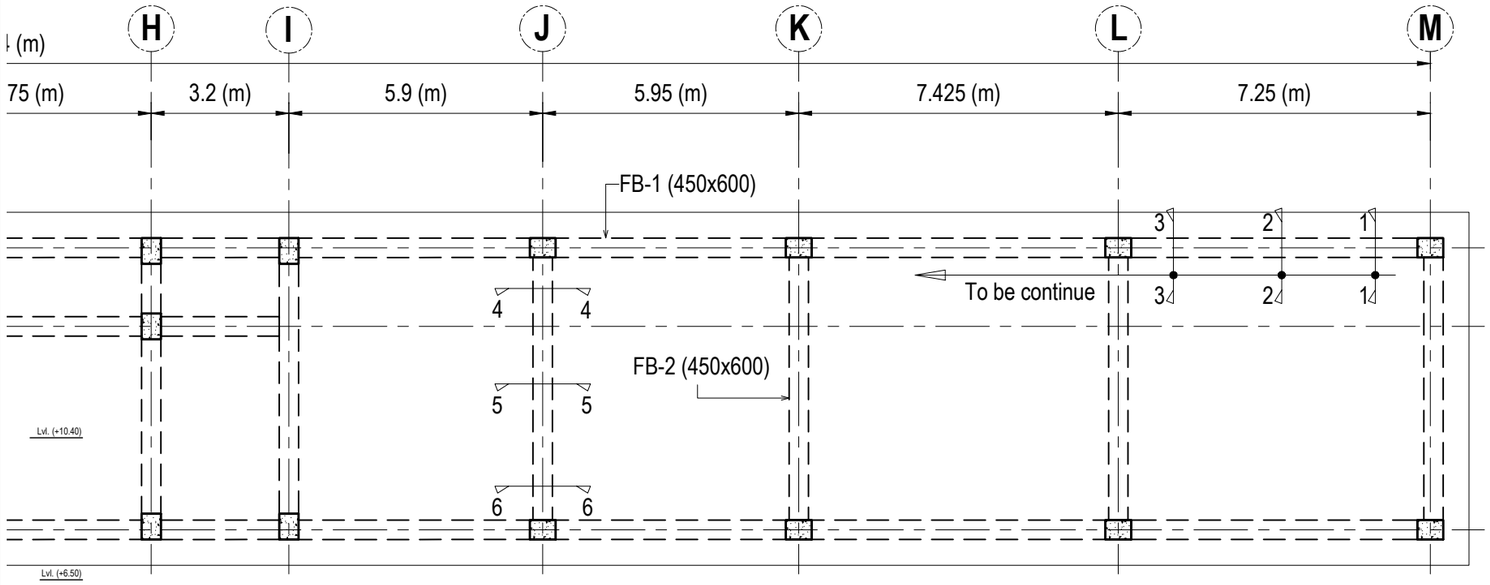
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Ground Floor Slab Reinforcement Details and Grade Beam Layout 2 of 2 CAD BY: / SCALE: AS SHOWN
			Revision History: 1. / 2. / 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-B-013



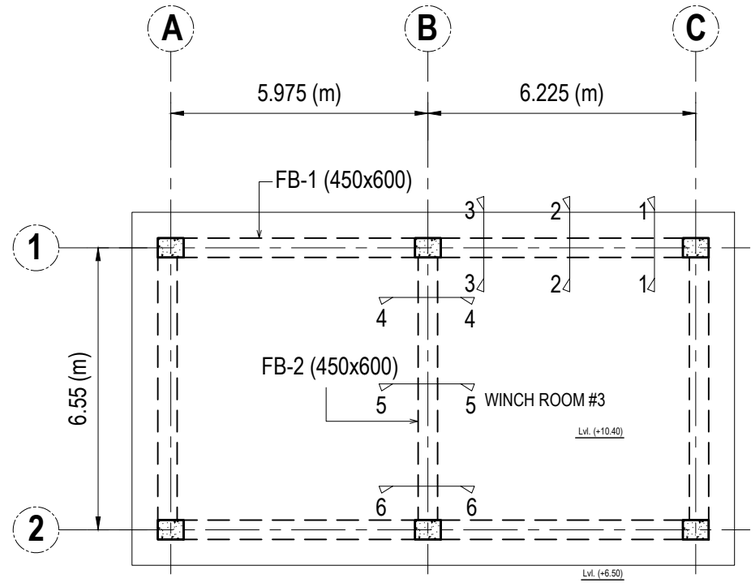
Winch Control Room #1
Floor Beam Layout Plan (Level +10.40 m)



Winch Control Room #2
Floor Beam Layout Plan (Level +10.40 m)



om #2
ı (Level +10.40 m)

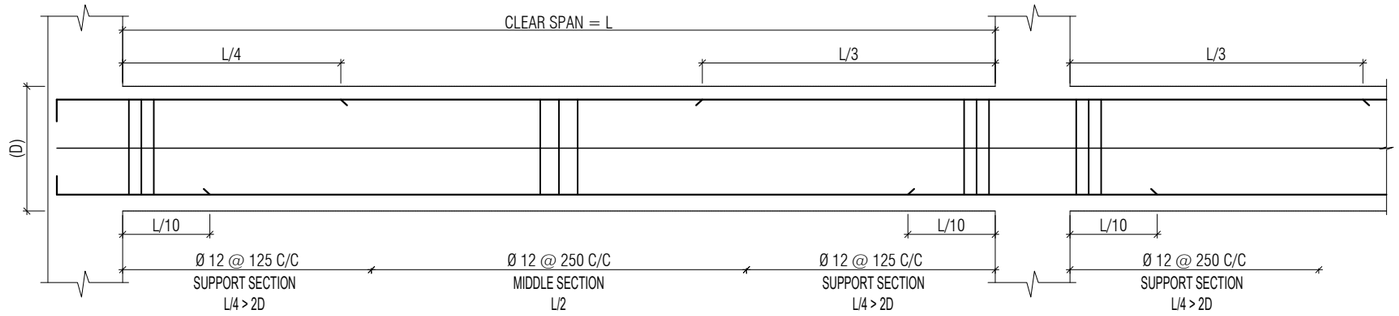


Winch Control Room #3
Floor Beam Layout Plan (Level +10.40 m)

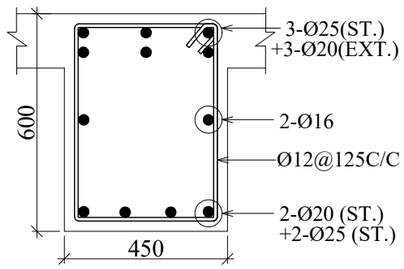
**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Floor Beam Layout Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-014	Date: 30-Apr-2025 Status: Revision: R-00

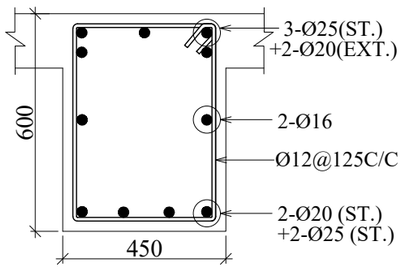
TENDER DRAWINGS



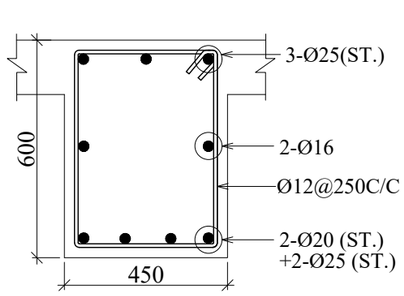
TYPICAL LONG SECTION OF FLOOR BEAM, FB



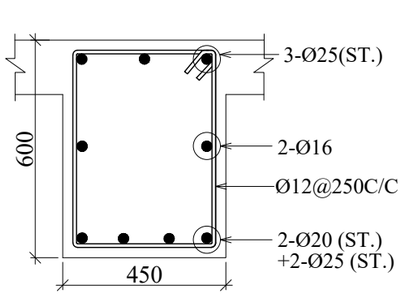
SEC. 1-1



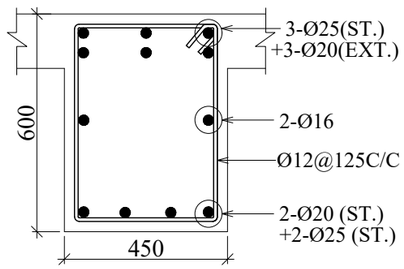
SEC. 4-4



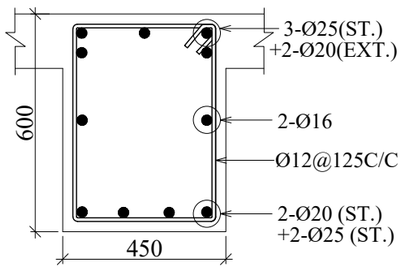
SEC. 2-2



SEC. 5-5



SEC. 3-3

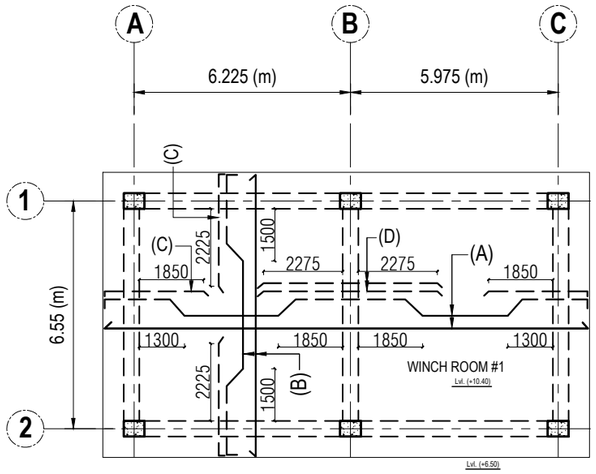


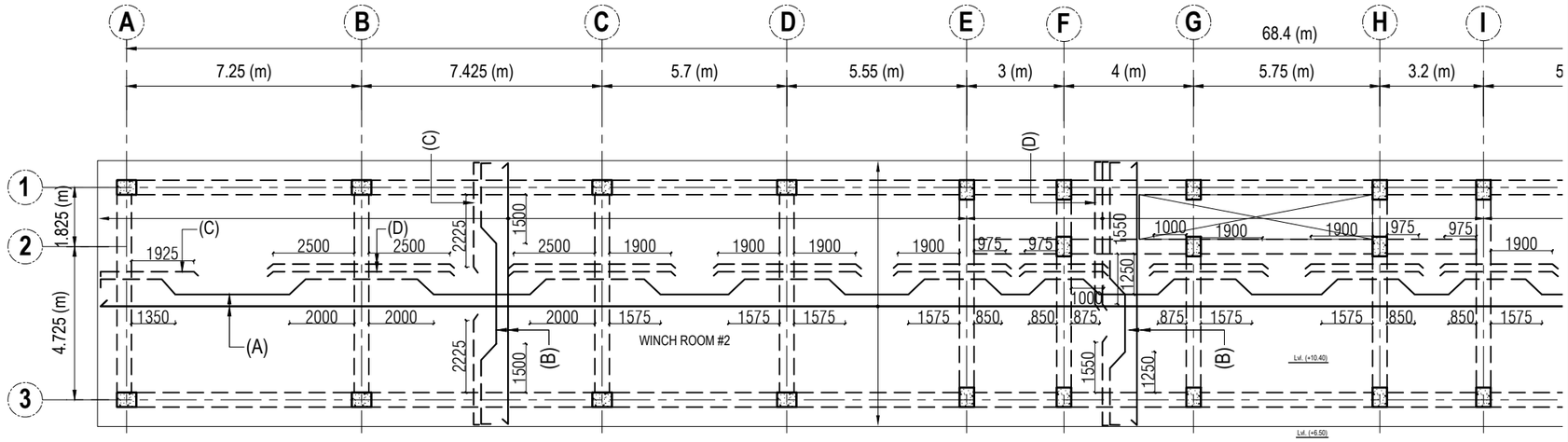
SEC. 6-6

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Section Details of Floor Beam CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-015	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS





Winch Control Room #1
Floor Slab Reinforcement Details
(Level +10.40 m)

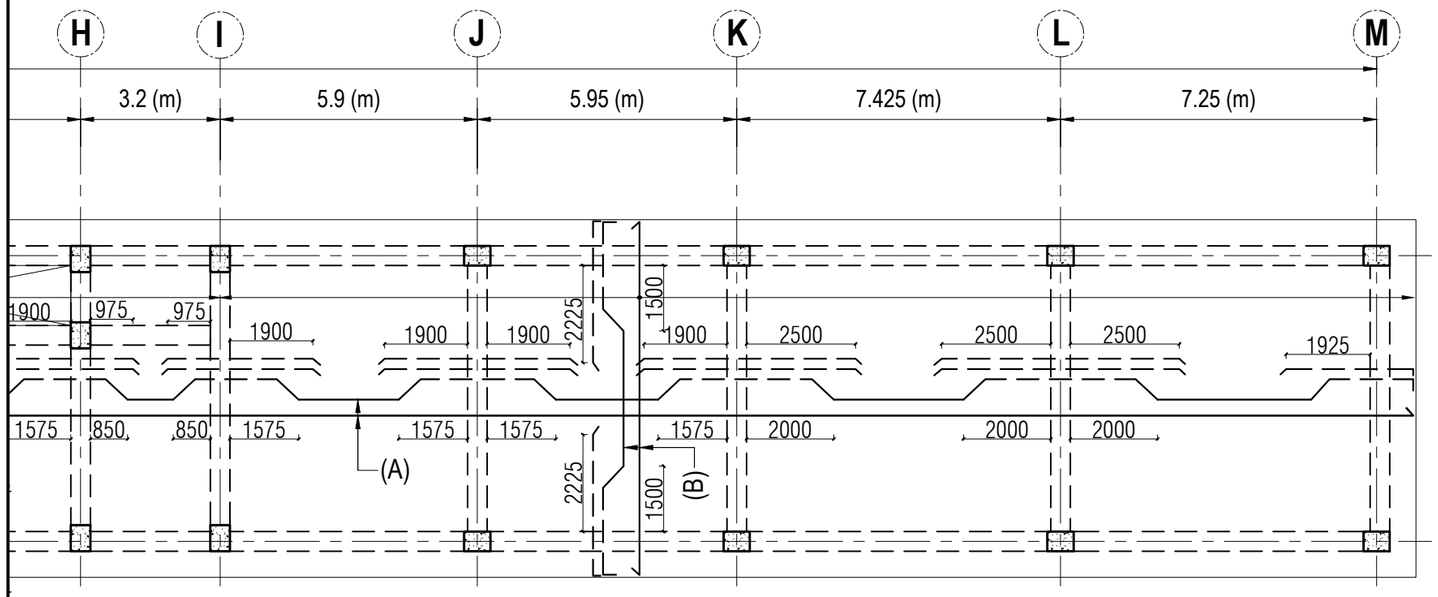
Winch Control Room #2
Floor Slab Reinforcement Details
(Level +10.40 m)

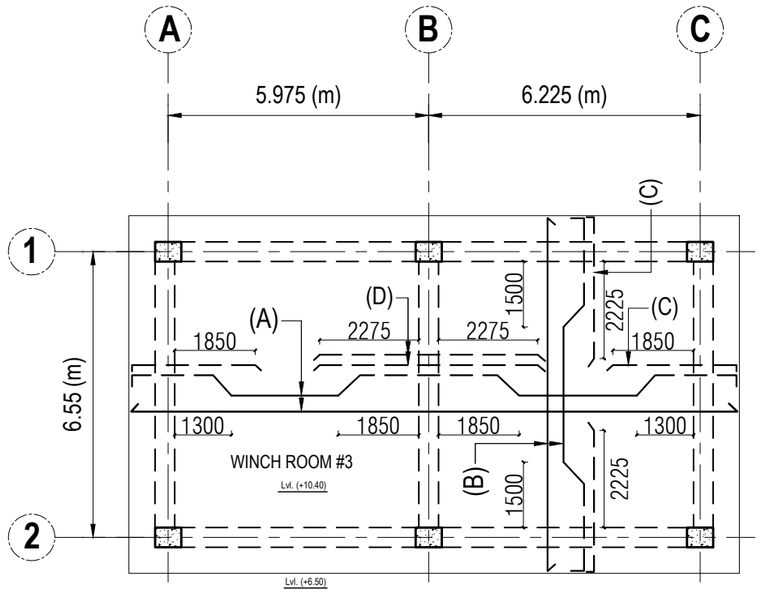
NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 150 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Typical Floor Slab Reinforcement Layout Plan 1 of 2 CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-B-016

TENDER DRAWINGS





NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 150 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

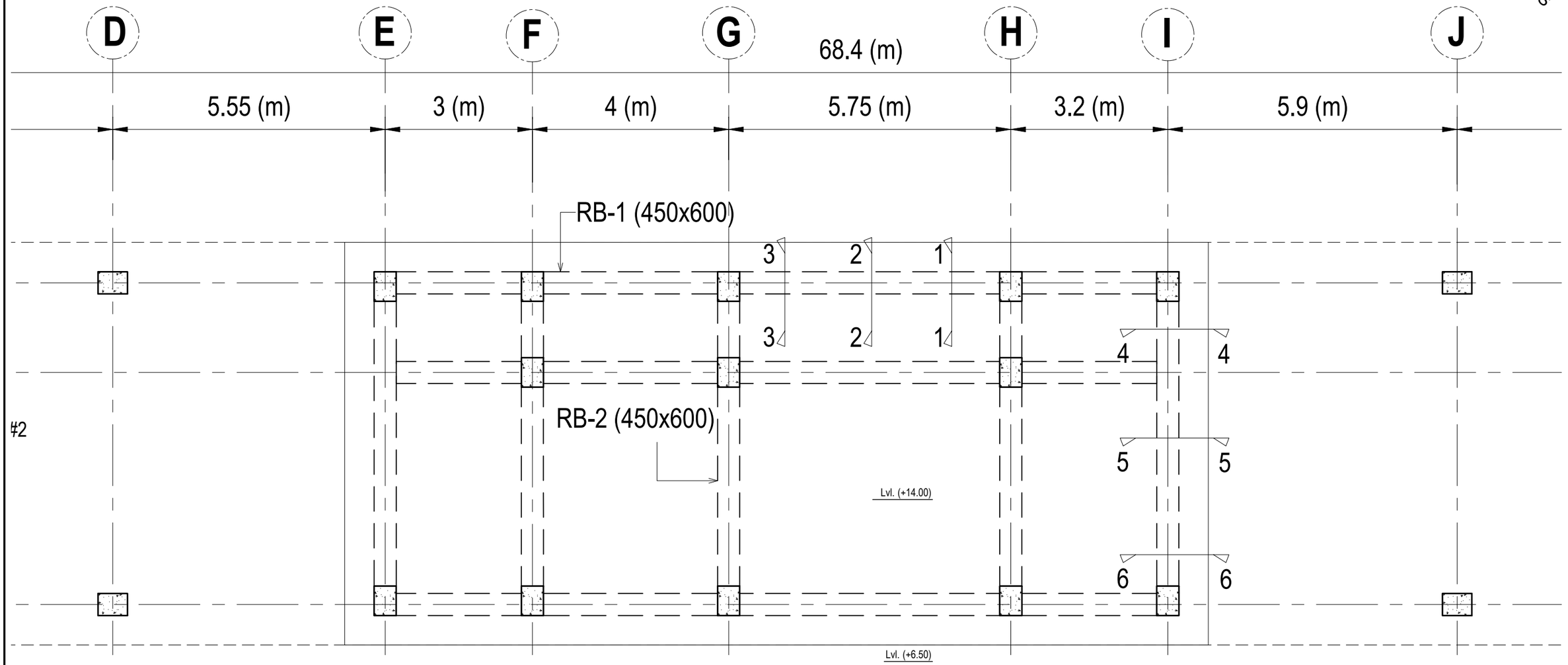
Winch Control Room #2
Floor Slab Reinforcement Details
(Level +10.40 m)

Winch Control Room #3
Floor Slab Reinforcement Details
(Level +10.40 m)

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Typical Floor Slab Reinforcement Layout Plan 2 of 2 CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-017	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



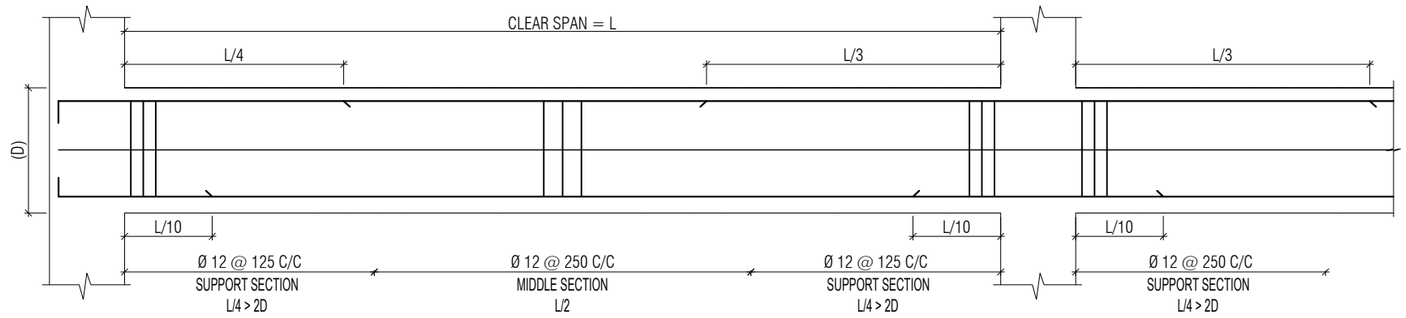
Winch Control Room #2

Roof Beam Layout Plan (Level +14.00 m)

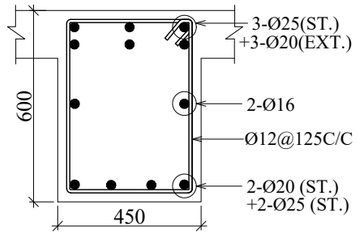
**All Levels are w.r.t. Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Roof Beam Layout Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-018	Date: 30-Apr-2025 Status: Revision: R-00

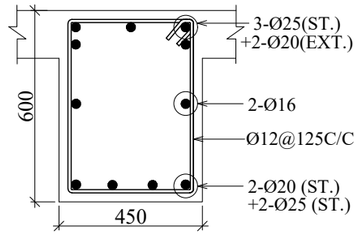
TENDER DRAWINGS



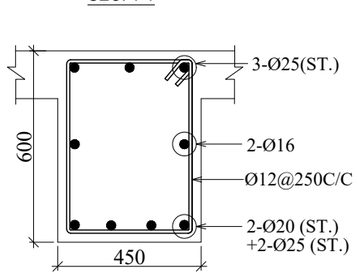
TYPICAL LONG SECTION OF ROOF BEAM, RB



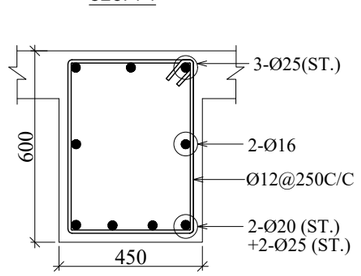
SEC. 1-1



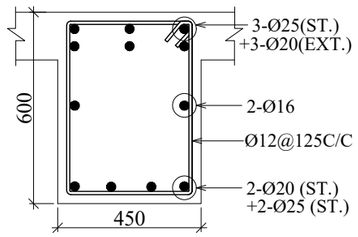
SEC. 4-4



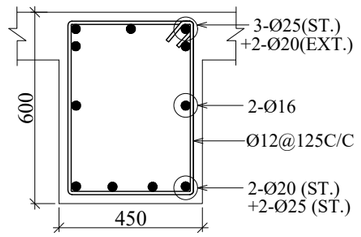
SEC. 2-2



SEC. 5-5



SEC. 3-3

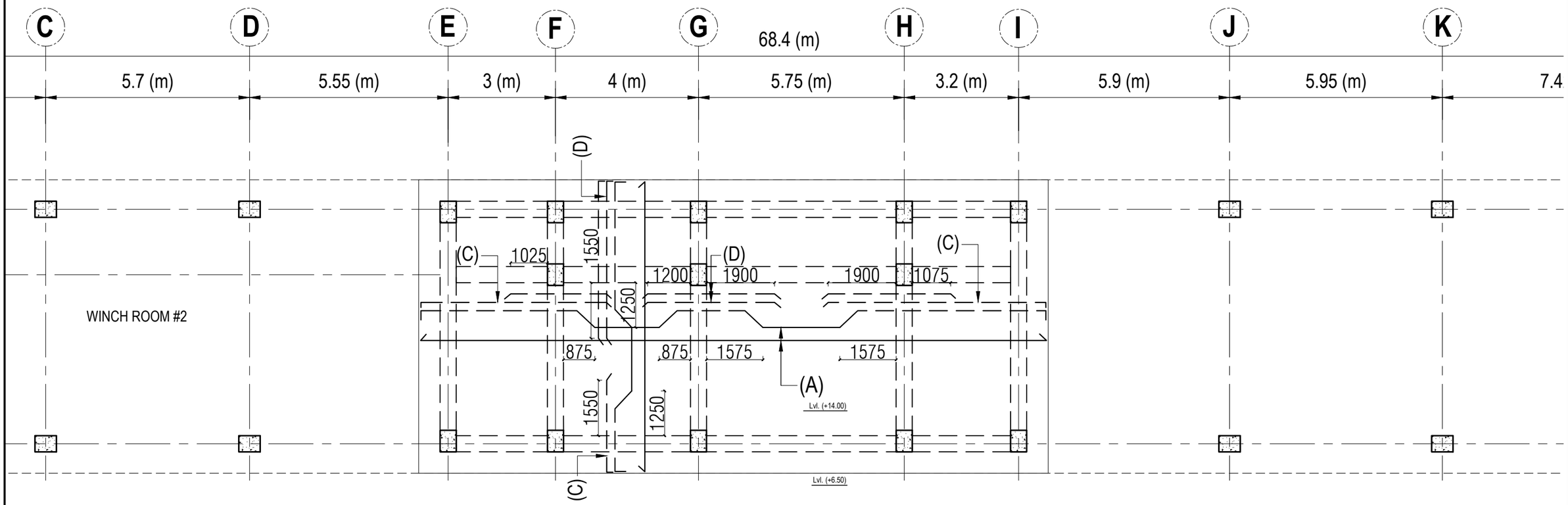


SEC. 6-6

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility		Revision History:	
			SHEET TITLE: Section Details of Roof Beam		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-019	

TENDER DRAWINGS



N

Winch Control Room #2

Roof Slab Reinforcement Details

(Level +14.00 m)

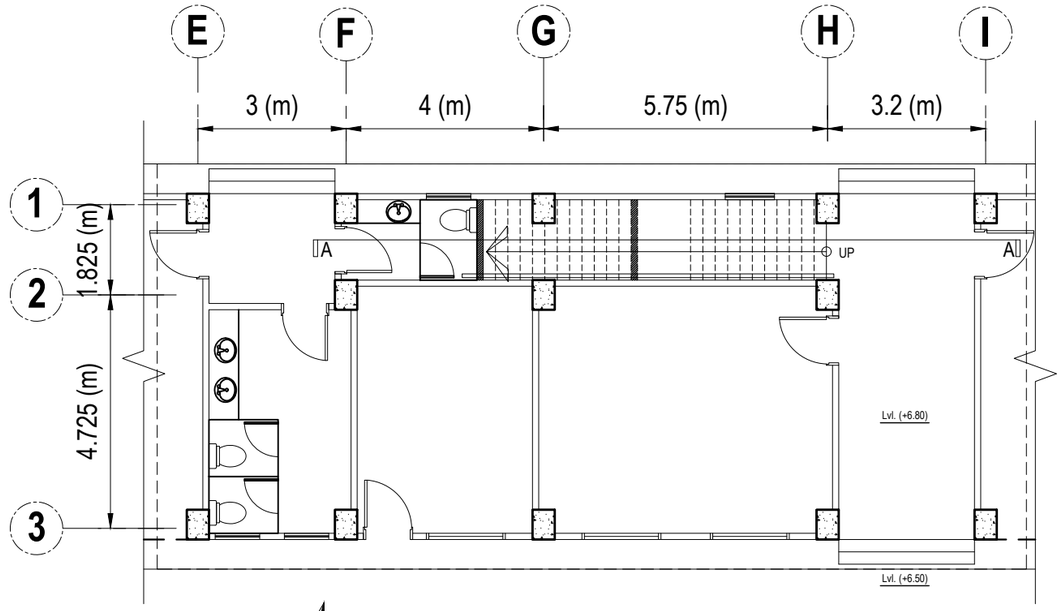
NOTES:

1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 150 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

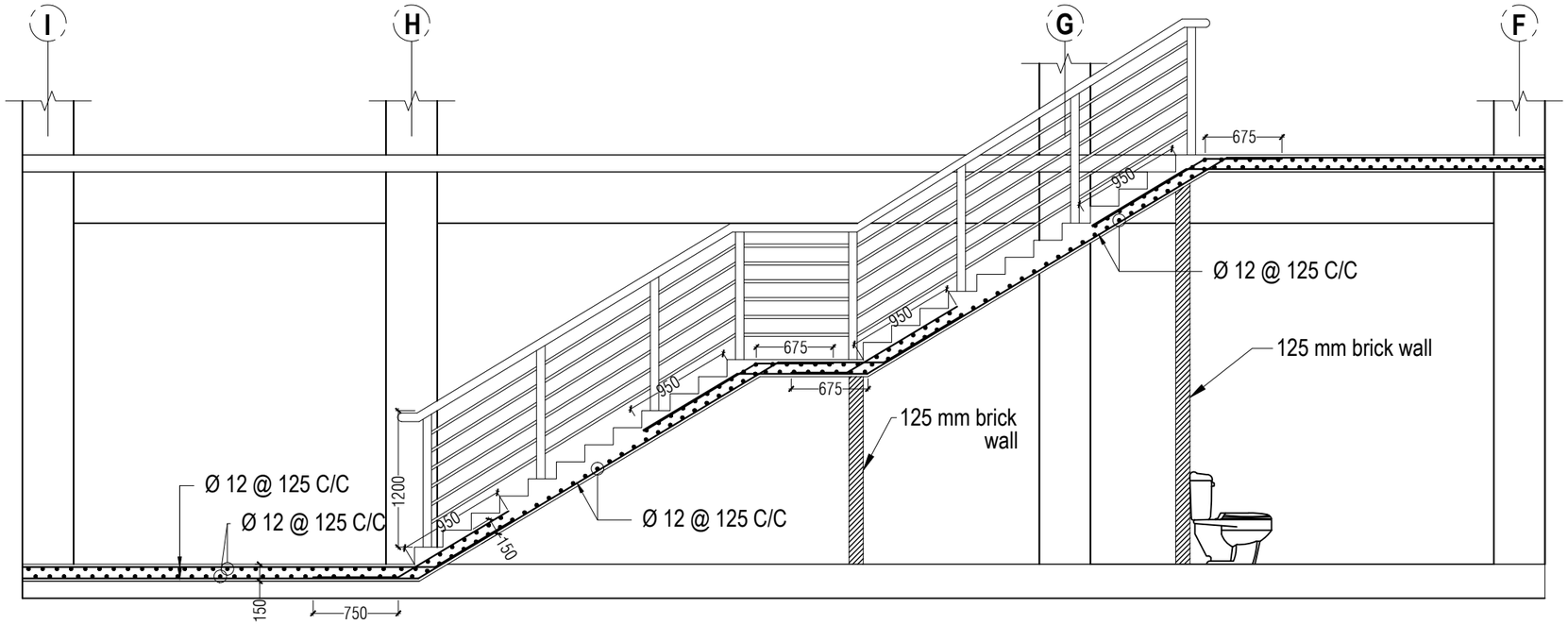
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Roof Slab Reinforcement Layout Plan CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-B-020	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



Winch Control Room #2
Stair Plan



Section A-A

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility		Revision History:	
			SHEET TITLE: Details of Stair		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-B-021	

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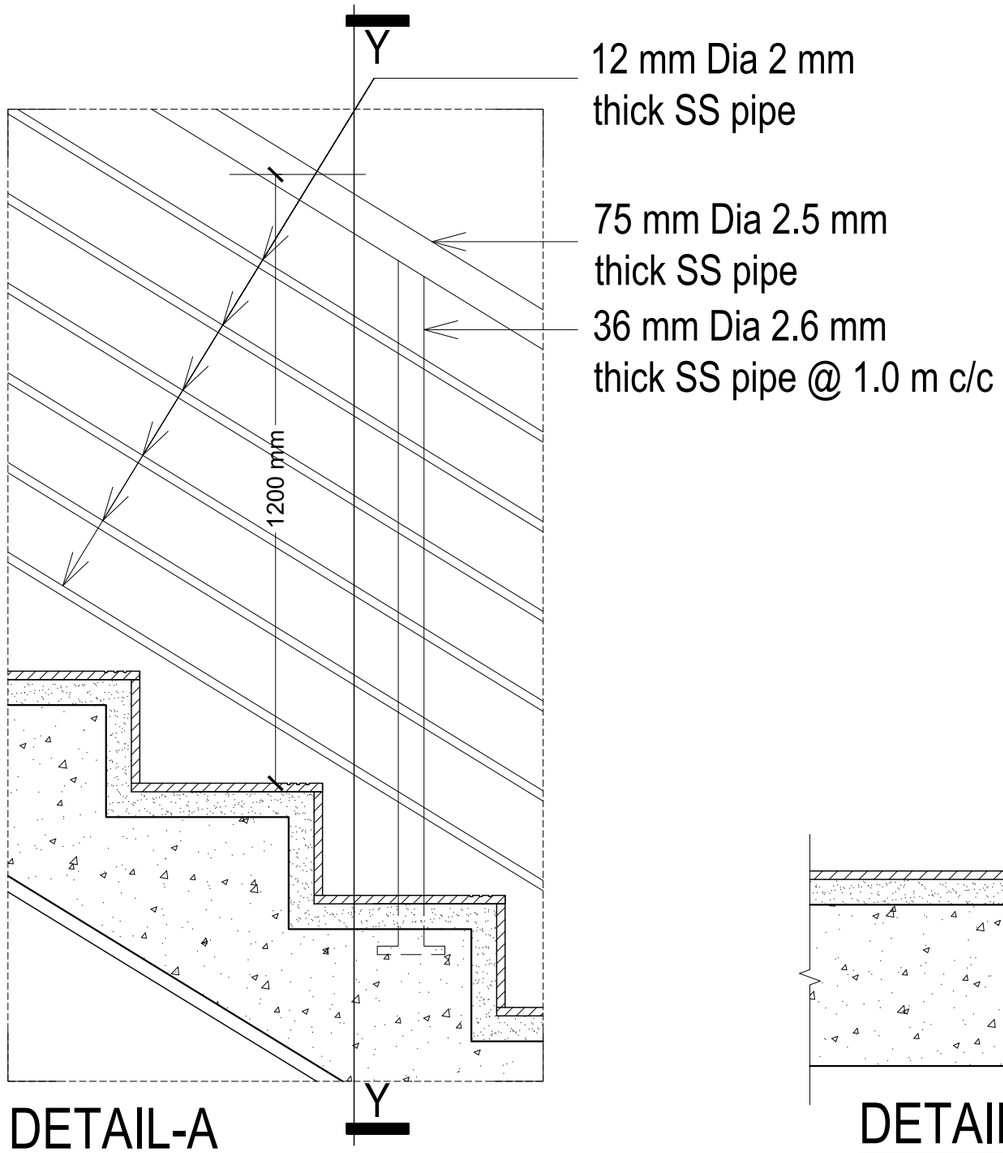
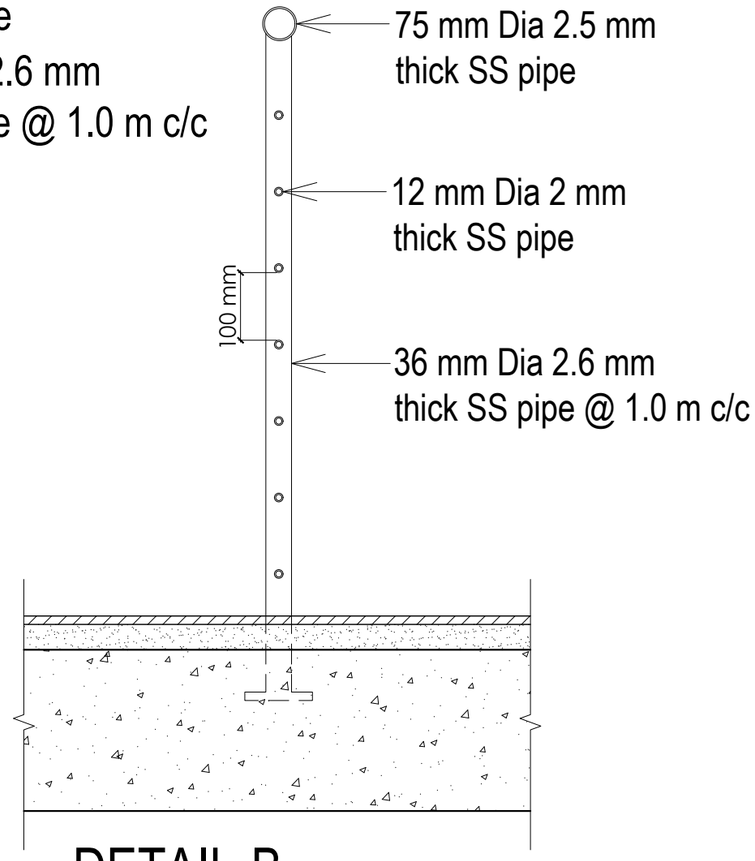
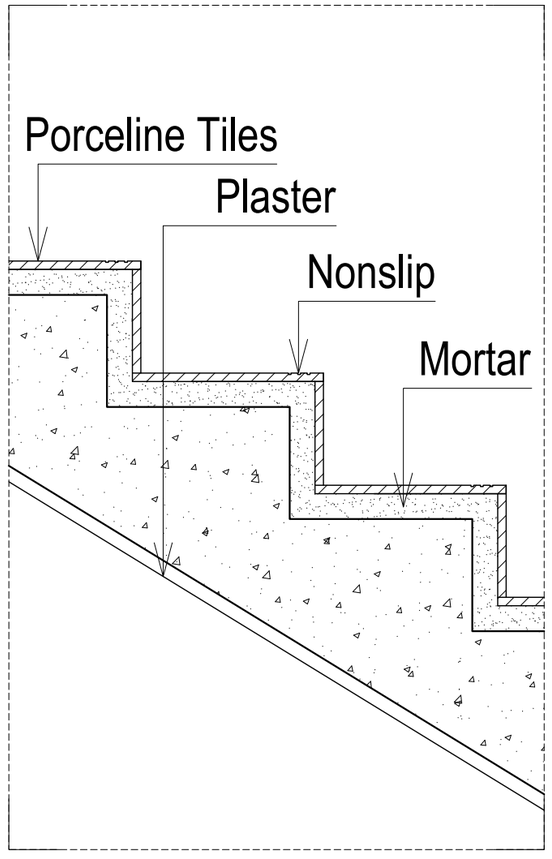


DETAIL-A



DETAIL-B



DETAIL-C

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Winch Control Facility SHEET TITLE: Typical Section of Stair Railing CAD BY: SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-B-022

TENDER DRAWINGS

ELECTRICAL LEGEND

Suffix	Symbol	Description	Mounting Height (Bottom)
MDB		Main Distribution Board	750mm Top from F.F.L
SDB		Sub Distribution Board	2250mm Top from F.F.L
SB		Electric Switch Board With 2-pin, 5A Socket ESB= Emergency switch board, Generator	1200mm Top from F.F.L
TL		1200mm-36 watt, LED Tube light	2250mm Top from F.F.L
F		Ceiling Fan, 1220 or 1422mm	Mounted at Ceiling from Hook
CL		Ceiling LED Light, 12 watt	Ceiling/ False Ceiling
EXF		300mm Exhaust Fan, 45 watt	2400mm Top from F.F.L
BL		Bracket LED light, 23/15/10 watt	2250mm Top from F.F.L
DP		3-Pin, 13A Flat Type Combined Switch Socket	200 or 750mm Top from F.F.L
M		5-Pin, 5/13A Multi Type Combined Switch Socket	200 or 750mm Top from F.F.L
TRL		Track Light , 12 watt LED, outside of building	1500mm Top from F.F.L
PL		Panel LED Light, 36W, at False Ceiling	At False Ceiling

INSTRUCTIONS:

*All wiring should be concealed inside building. Contractor should prepare and approve before commence to work.

*All conduits for point wiring should be 25mm pvc pipe unless specified otherwise.

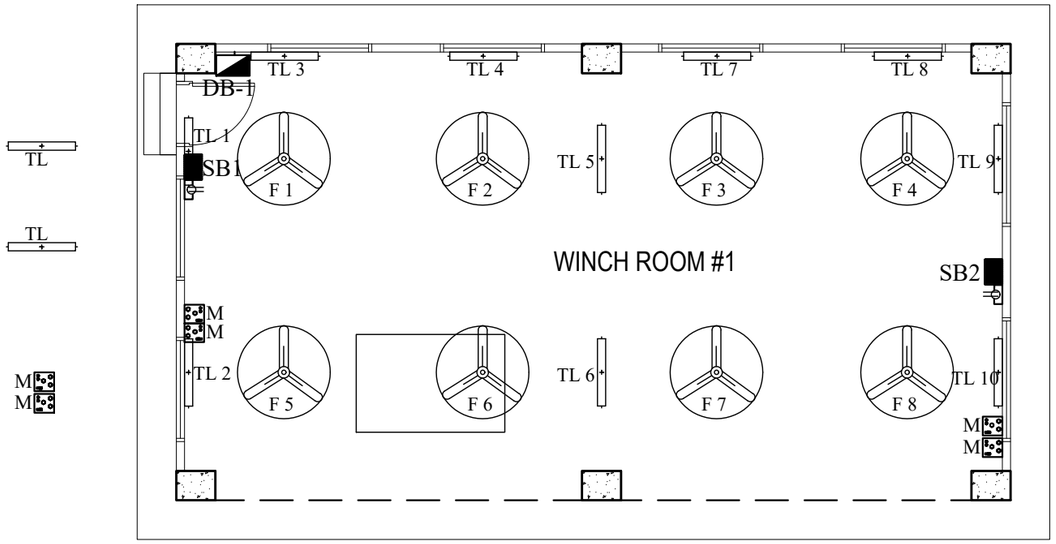
*All conduits for main electric cable from LT panel and CDB (Common Distribution Board) should be minimum 50mm pvc pipe or higher if required according to cable size.

*Use separate conduit pvc pipe for electrical fixture & power sockets and telecommunication points

*Use the cable schedule as defined in the Single Line Diagram of relevant drawing for electrical & telecom point wiring.
*1c-2x1.5 sq. mm BYA for light & fan point
*1c-2x2.5sq. mm BYA+1c-2.5 sq. mm BYA (green) for circuit & power point.
*1c-2x4.0 sq. mm BYA+1c-4.0 sq. mm BYA (green) for 1-ϕ a/c point
*1c-4x4.0 sq. mm BYA+1c-4.0 sq. mm BYA (green) for 3-ϕ, 4ton/ 5ton a/c point

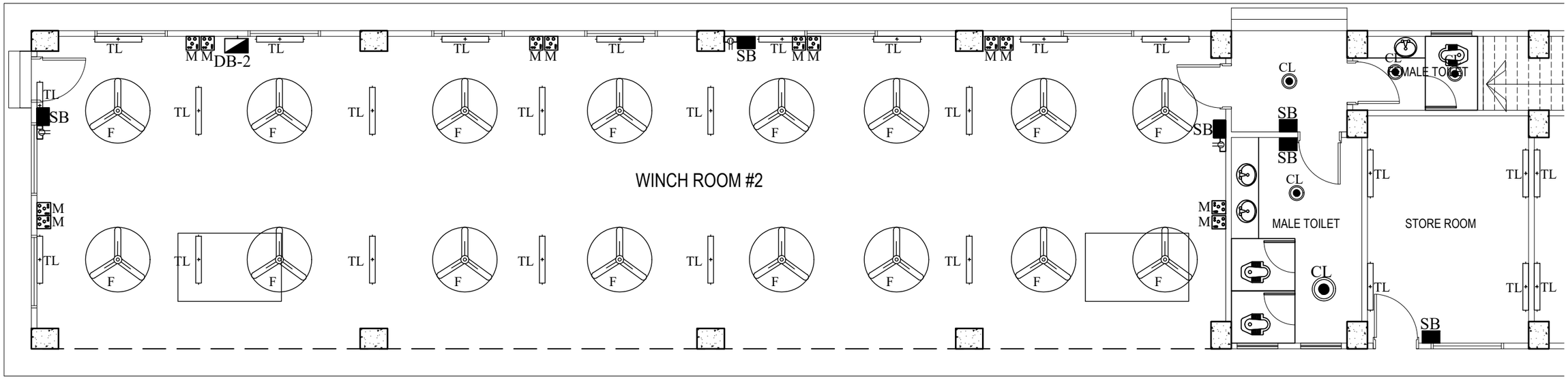
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Winch Control Facility SHEET TITLE: Electrical Legend	Revision History: 1. 2. 3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN
			Drg No. D-07-C-001	Date: 30-Apr-2025 Status: Revision:

TENDER DRAWINGS



Winch Control Room #1

Ground Floor Plan

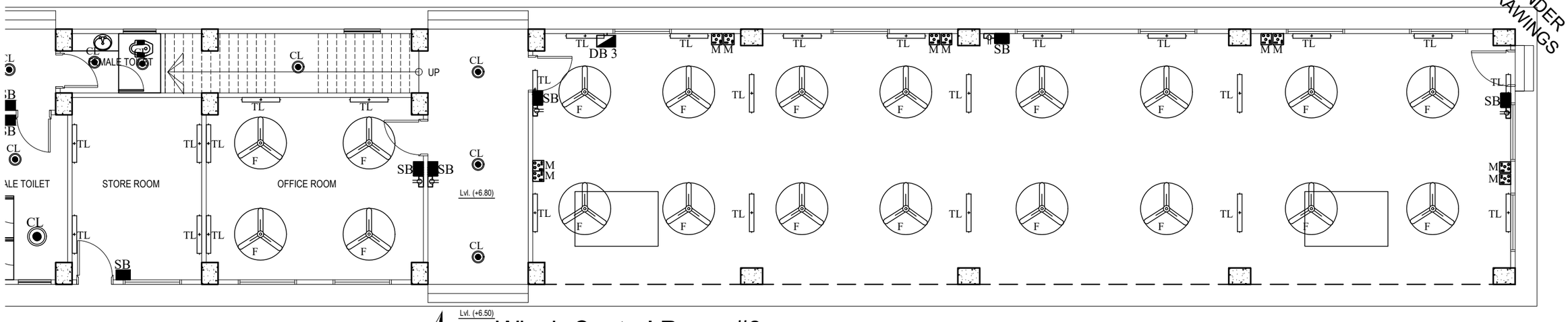


Winch Control Room #2

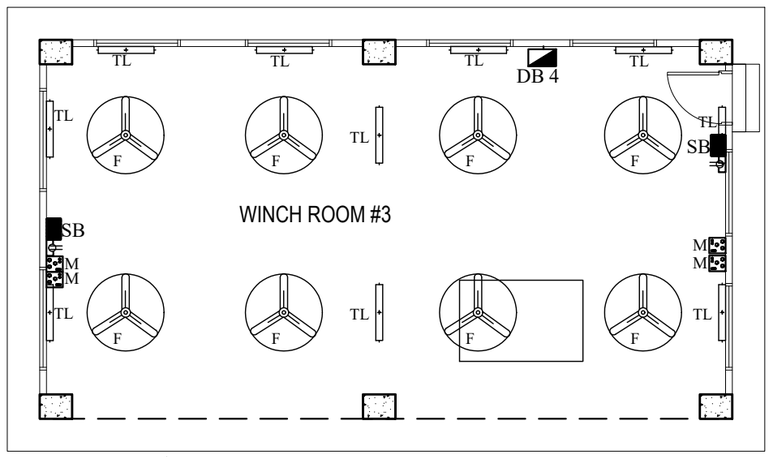
Ground Floor Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Winch Control Facility SHEET TITLE: Electrical Fixture Layout (Partial view: 01, North side to middle Portion) Ground Floor. CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-C-002	Date: 30-Apr-2025 Status: Revision:

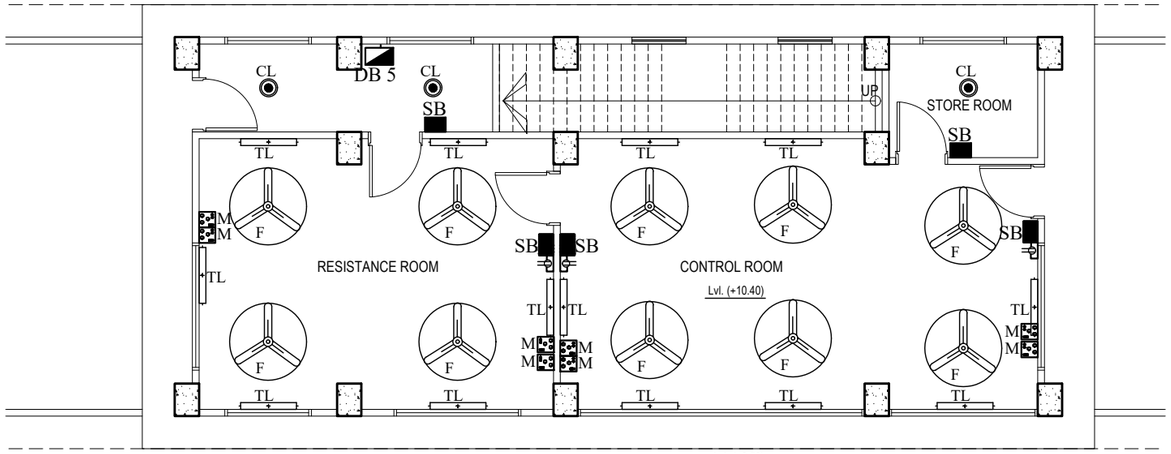
TENDER DRAWINGS



Winch Control Room #2
Ground Floor Plan



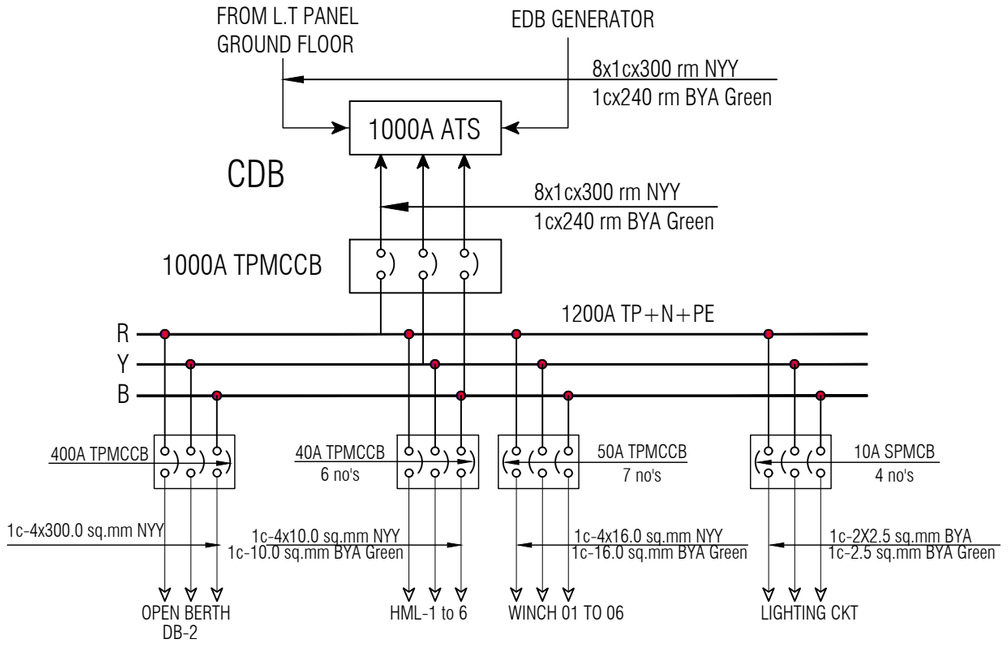
Winch Control Room #3
Ground Floor Plan

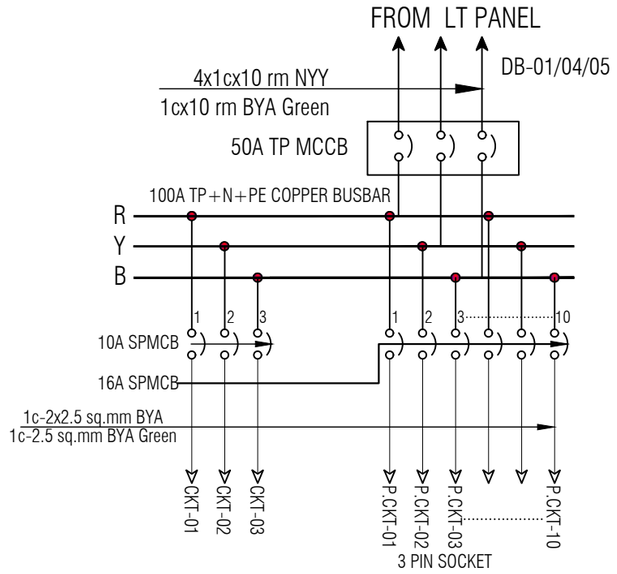


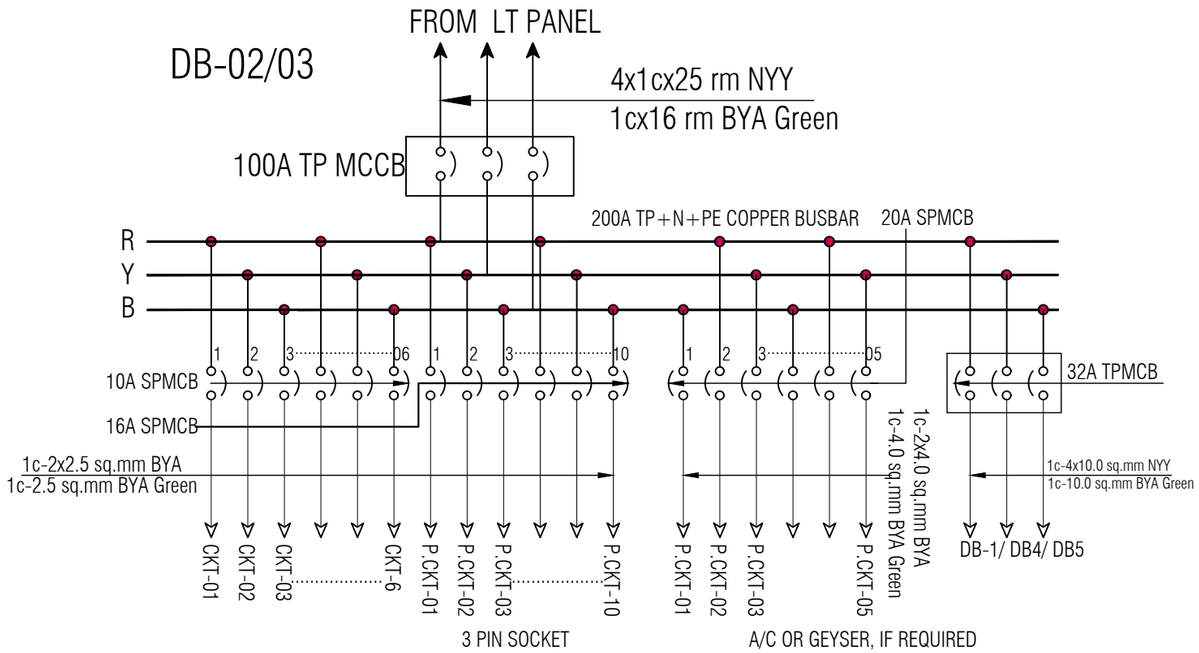
Winch Control Room #2
1st Floor Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Winch Control Facility SHEET TITLE: Electrical Fixture Layout (Partial view: 02, Middle to North side Portion) Ground Floor. CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-C-003	Date: 30-Apr-2025 Status: Revision:

TENDER DRAWINGS

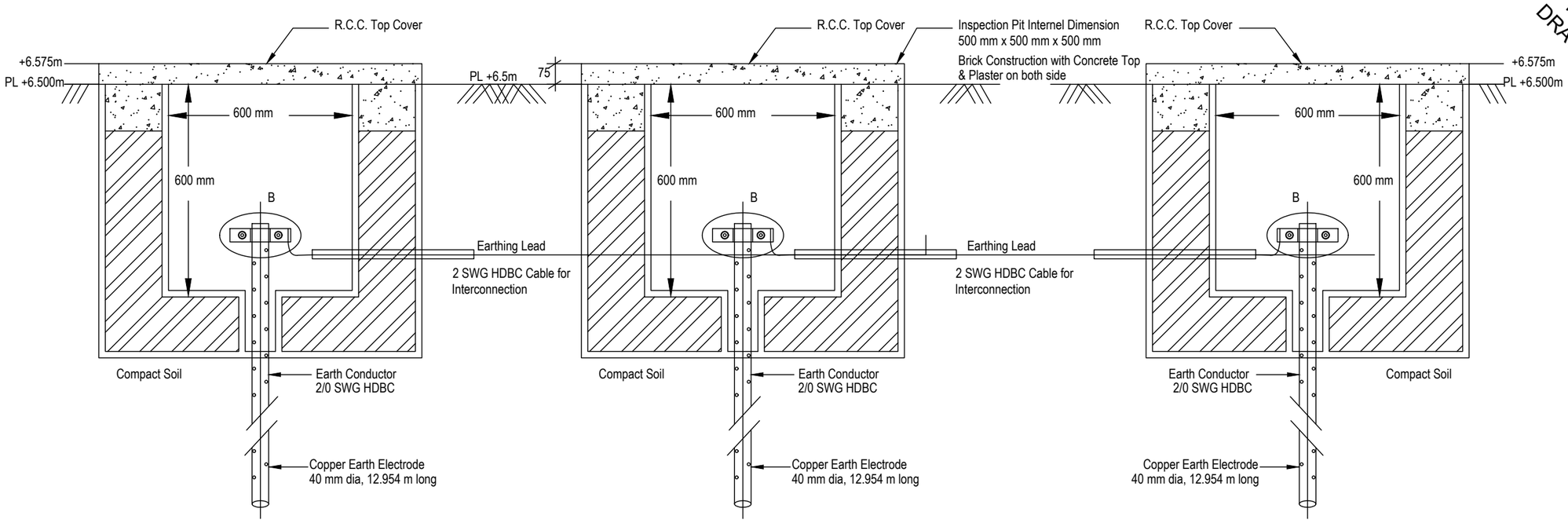






PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Winch Control Facility SHEET TITLE: Single Line Diagram of CDB - 01 and DB-GF-01/02 Ground Floor CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: Drg No. D-07-C-004

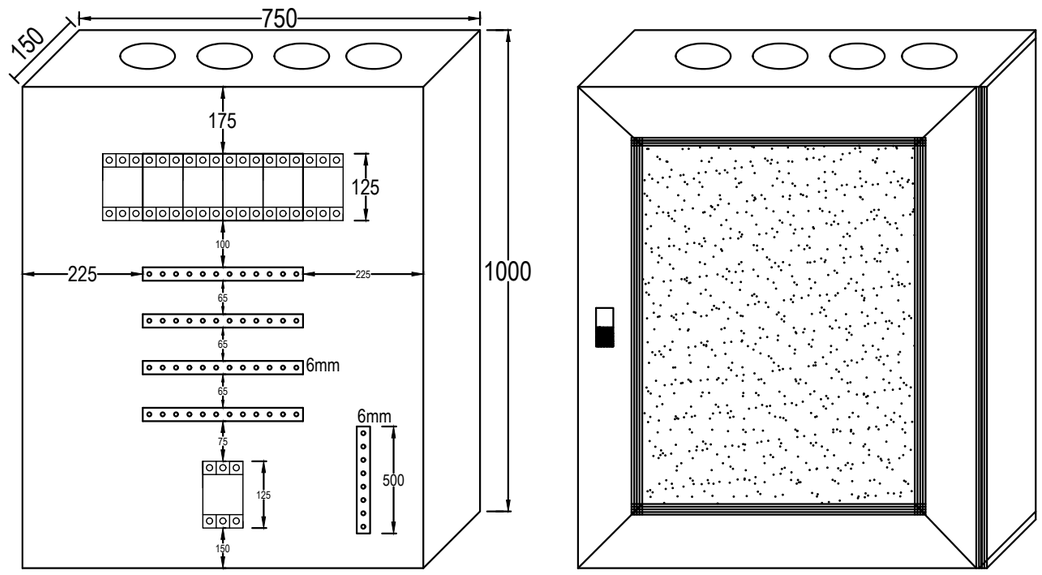
TENDER DRAWINGS

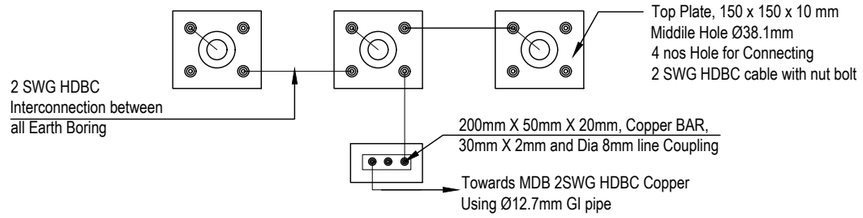


Detail - A
Inspection Pit, Earth Electrode For System Earthing

Detail - A
Inspection Pit, Earth Electrode For System Earthing

Detail - A
Inspection Pit, Earth Electrode For System Earthing





Detail - B: Connection of Copper Plate with Test Box

Schematic Diagram Outdoor Distribution Board (IP66)
Provide Extra Shade for Weather Protection

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Winch Control Facility		Revision History:	
			SHEET TITLE: System and Body Earthing Details for Winch Operation and Control System Schematic Diagram of Distribution Board		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision:
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-07-C-005	

TENDER DRAWINGS

GENERAL NOTE

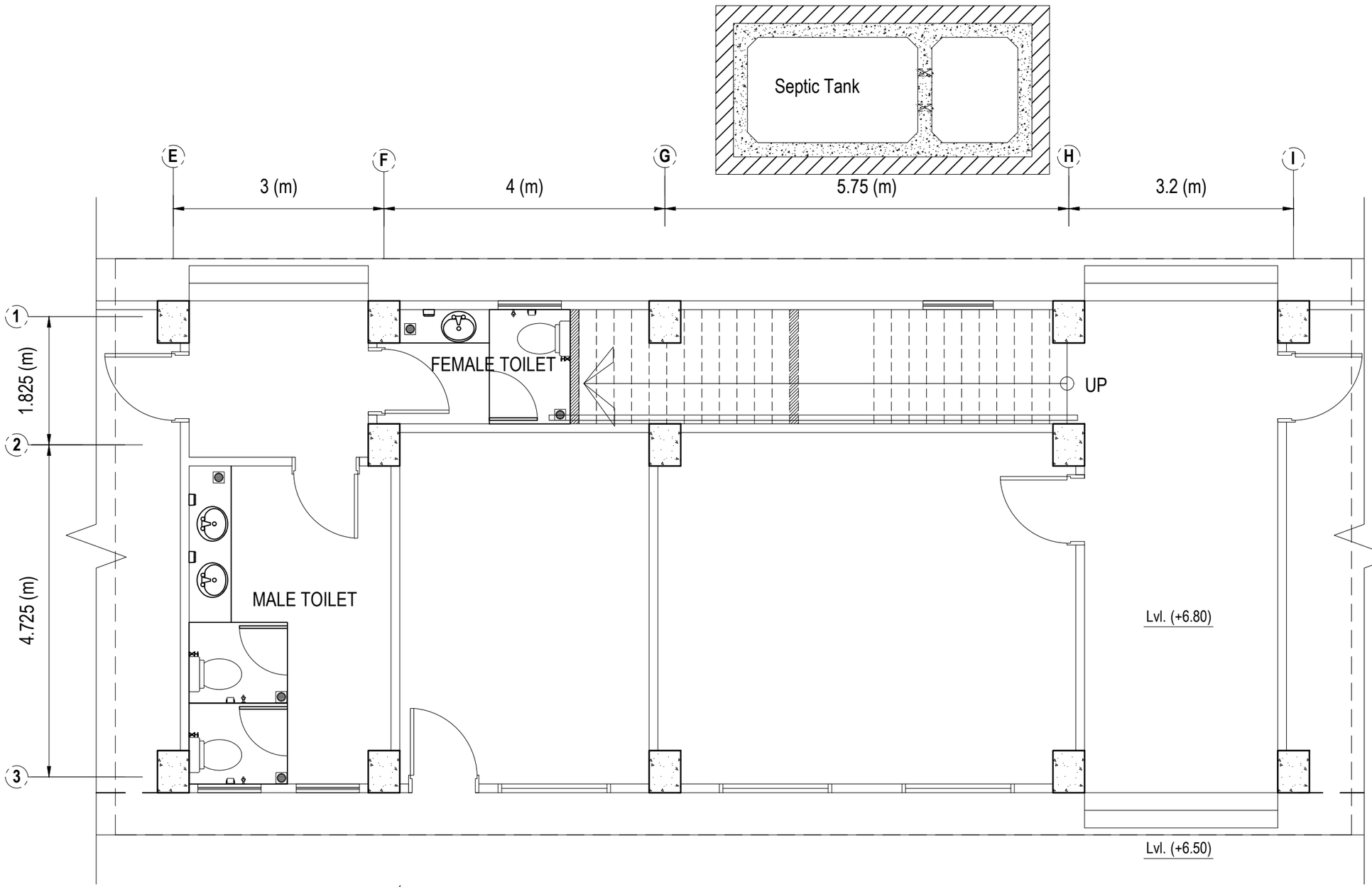
1. All horizontal pipe shall be laid at a slope of minimum 1 : 100
2. All water supply pipe shall be CPVC or GI
3. All water heater inlet and outlet pipes shall be CPVC or GI
4. All GAS inlet and outlet pipe shall be GI or MS best quality
5. Minor change of location of pipes to be adjust as per site condition
6. Horizontal water supply line at roof will be 75mm dia cPVC

ABBREVIATION

1. UPVC - Unplasticized Polyvinyl Chloride
2. CPVC - Chlorinated Polyvinyl Chloride
3. C - Cold
4. H - Hot
5. FC - False Ceiling
6. GI - Galvanizing Iron
7. OHWT - Over Head Water Tank
8. UGWR - Under Ground Water Reservoir
9. TL - Toilet
10. SS - Soil Stack
11. WS - Waste Stack
12. RWS - Rain Water Stack
13. RW - Rain Water
14. FT - Female toilet
15. WP - Waste Water pit
16. WR - Water Riser
17. WH - Water Heater
18. SP - Soil pit
19. MT - Male toilet

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility	Revision History:	
			SHEET TITLE: General notes	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-07-D-001	

TENDER DRAWINGS



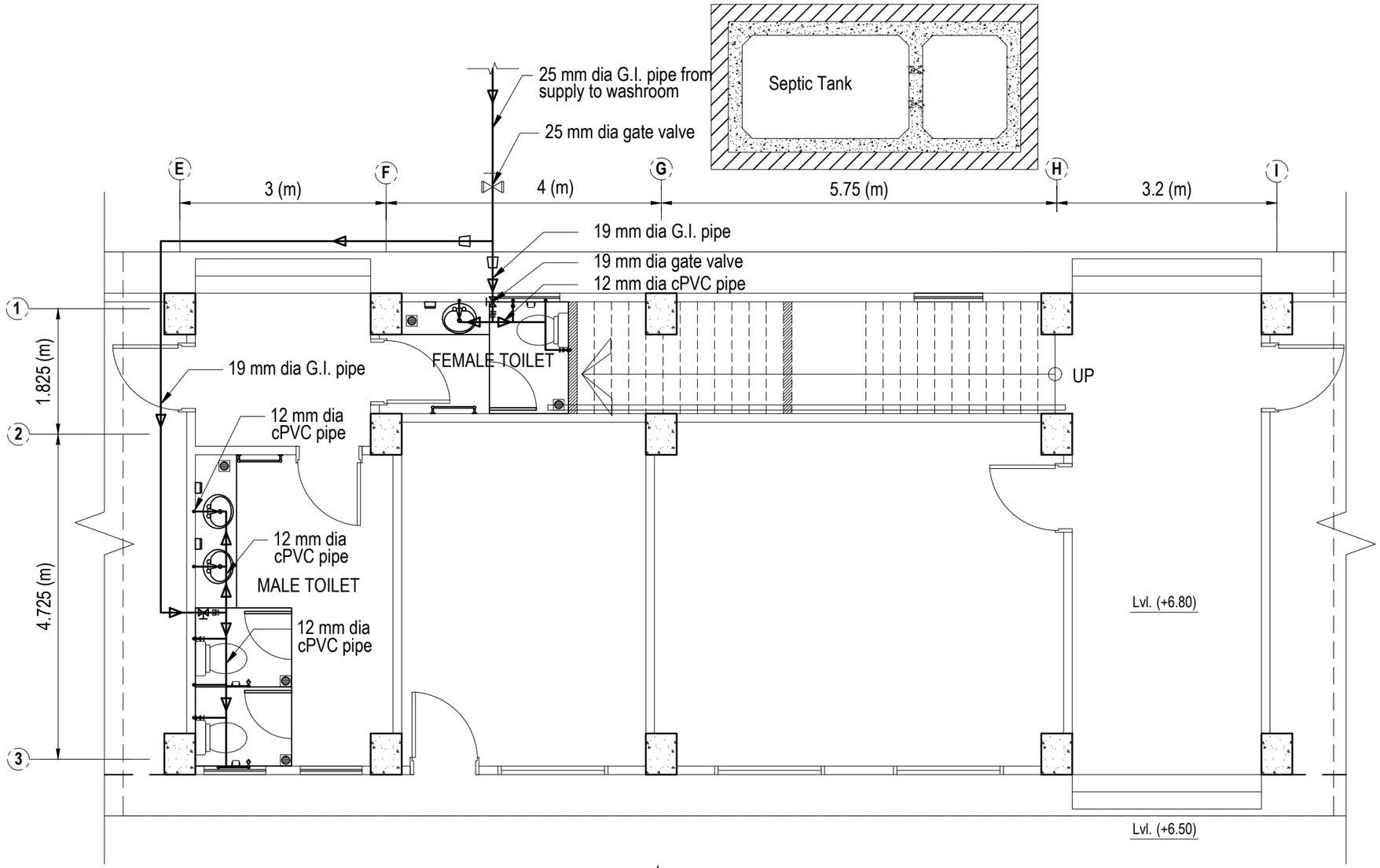
N

Winch Control Room #2

Washroom Layout Plan

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility SHEET TITLE: Washroom Layout Plan CAD BY: / SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-D-02

TENDER DRAWINGS



N

Winch Control Room #2

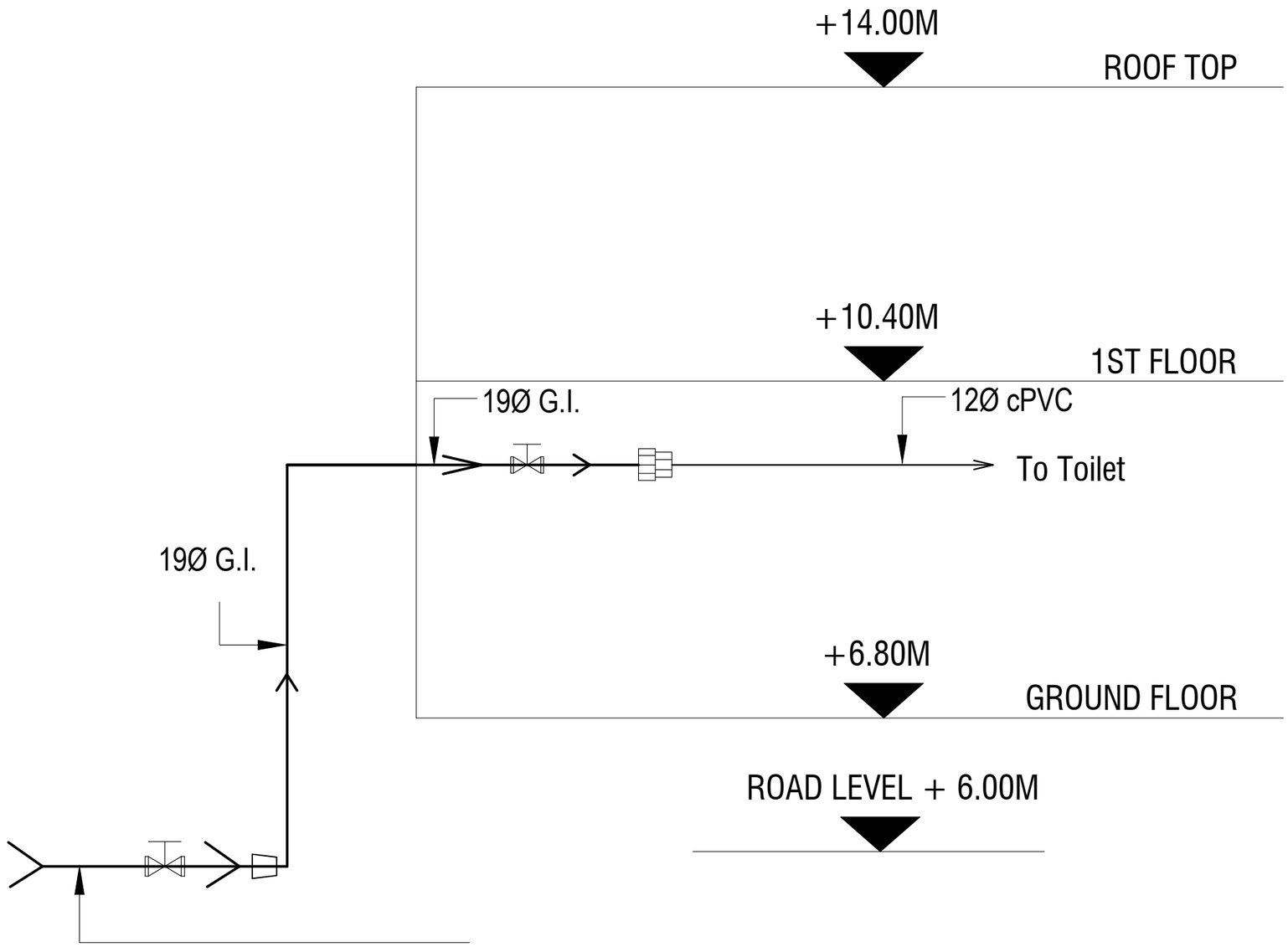
Washroom Layout Plan

Legend

- Gate Valve
- Ball Valve
- Reducer
- cPVC Brass Socket
- Towel Rail
- Bib Cock
- Angle Stop Cock
- Pillar Cock
- Floor Trap
- Tissue Holder
- Angular Stop Cock
- Push Shower
- Soap Dispenser

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility	Revision History:
			SHEET TITLE: Details of Water Supply Layout	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-07-D-03

TENDER DRAWINGS

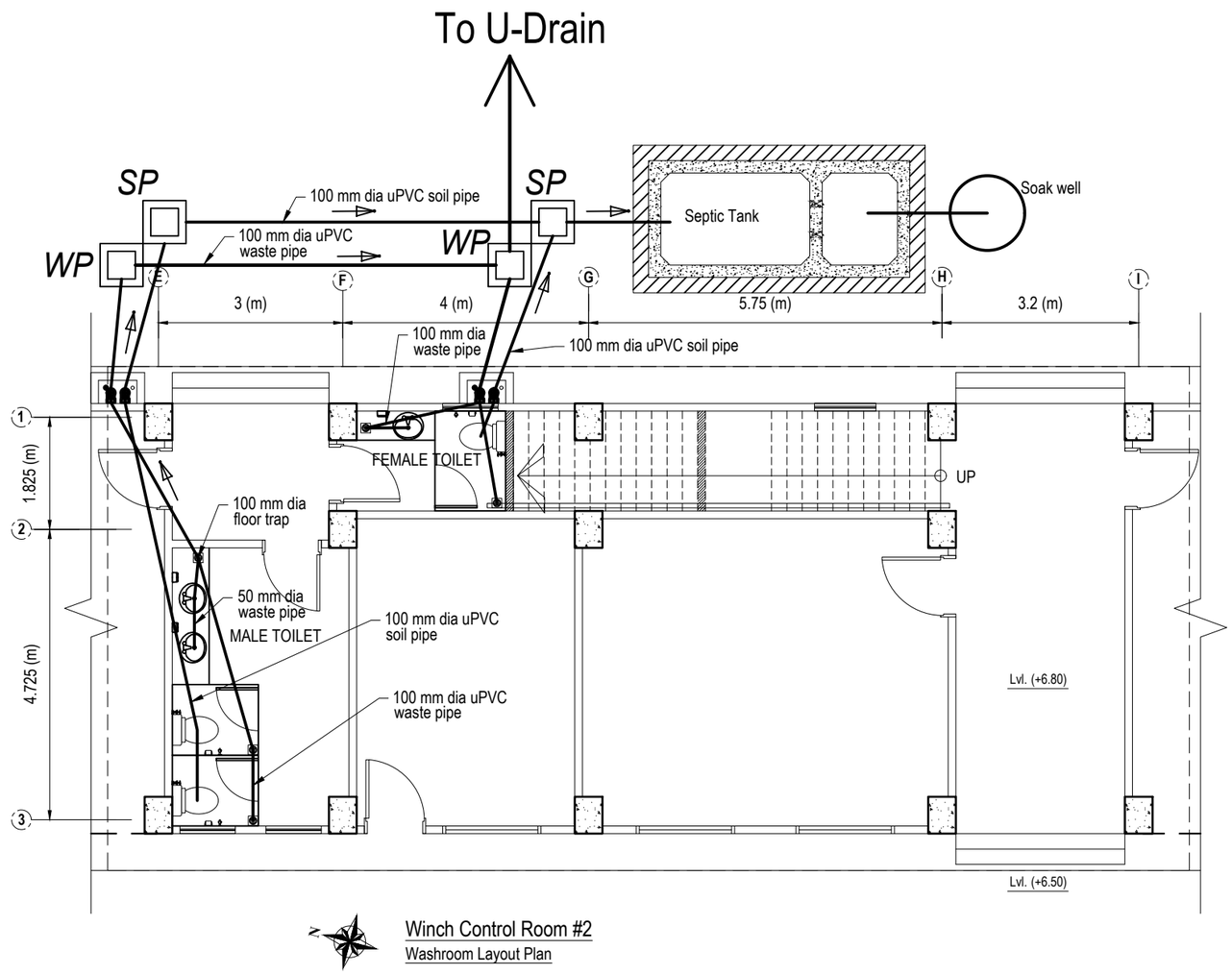


Typical distribution pipe for water supply

(Not to scale)

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility	Revision History:
			SHEET TITLE: Distribution Pipe for Water Supply	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-07-D-04

TENDER DRAWINGS



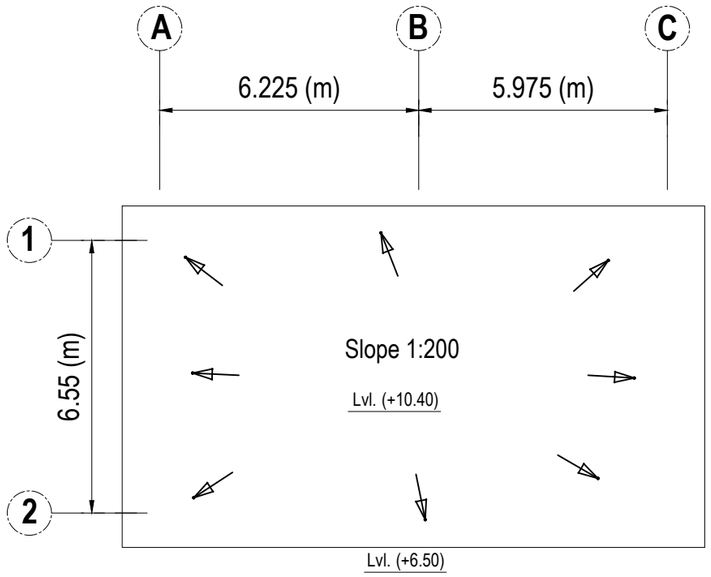
Winch Control Room #2

Washroom Layout Plan

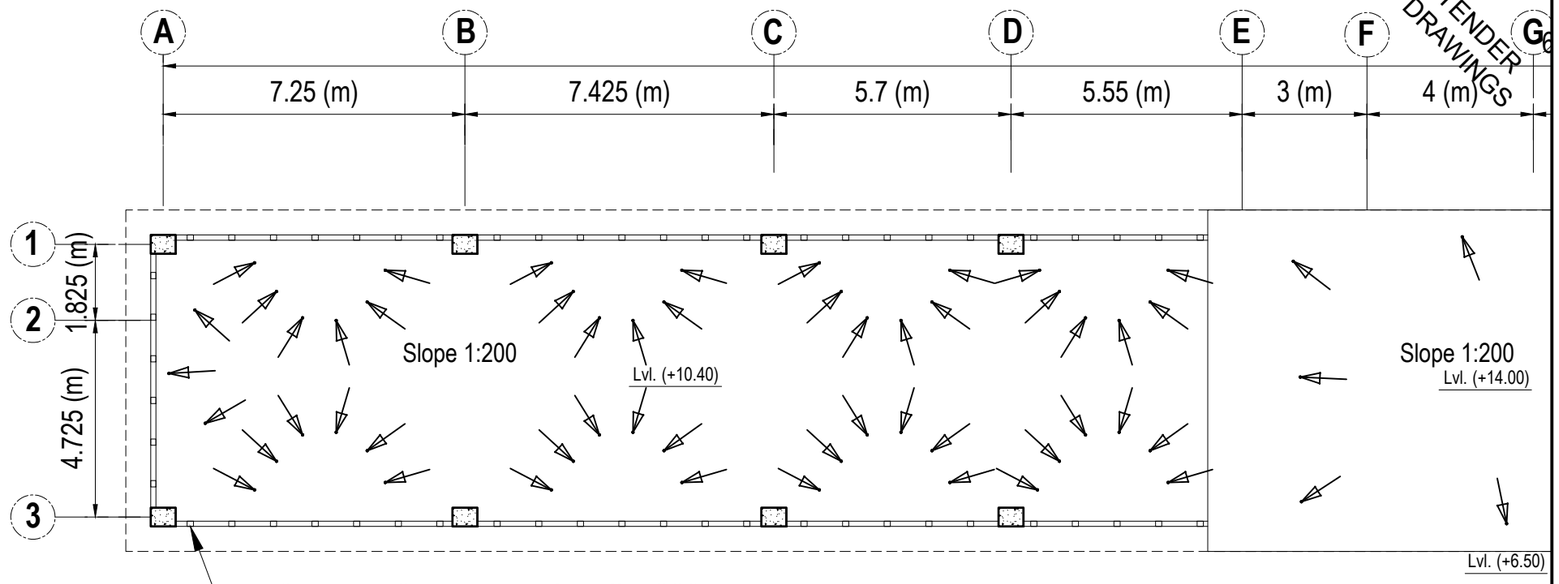
Legend

- Gate Valve
- Ball Valve
- Reducer
- cPVC Brass Socket
- Towel Rail
- Bib Cock
- Angle Stop Cock
- Pillar Cock
- Floor Trap
- Tissue Holder
- Angular Stop Cock
- Push Shower
- Soap Dispenser

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility	Revision History:
			SHEET TITLE: Ground Floor Sanitary and Wastewater Drainage Layout	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-07-D-005

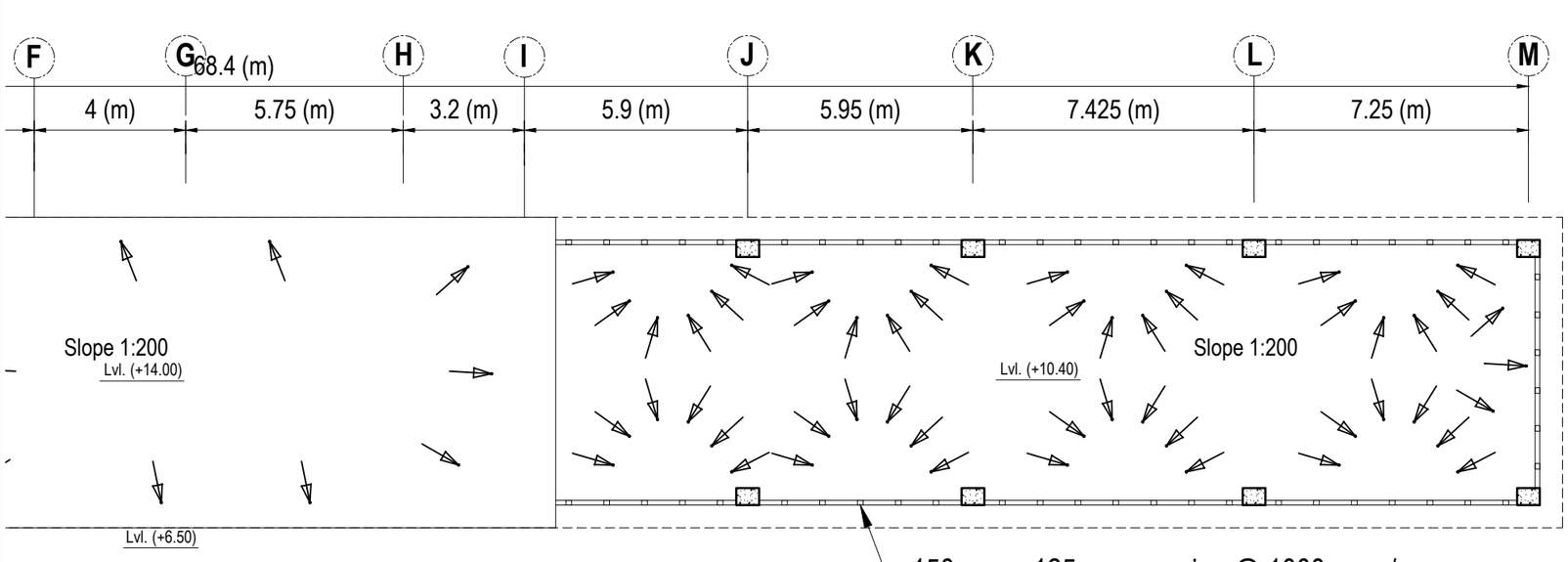


Winch Control Room #1
Rain Water Drainage Plan

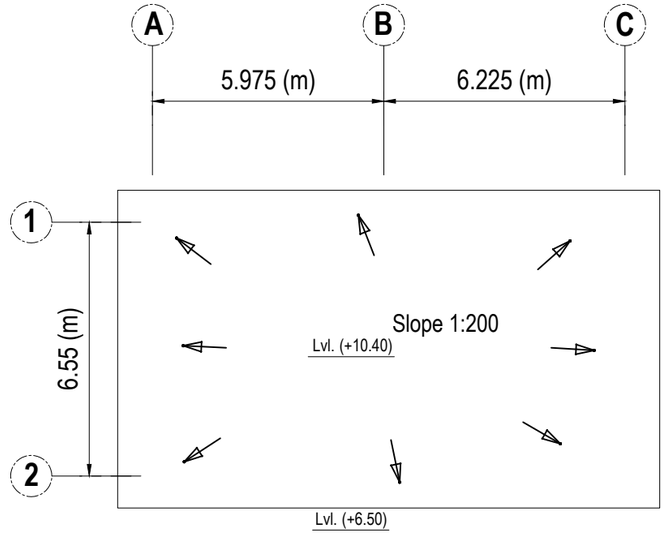


Winch C
Rain Water

TENDER DRAWINGS



Winch Control Room #2
Rain Water Drainage Plan



Winch Control Room #3
Rain Water Drainage Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility SHEET TITLE: Rainwater Drainage System of Roof CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-D-06
				Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

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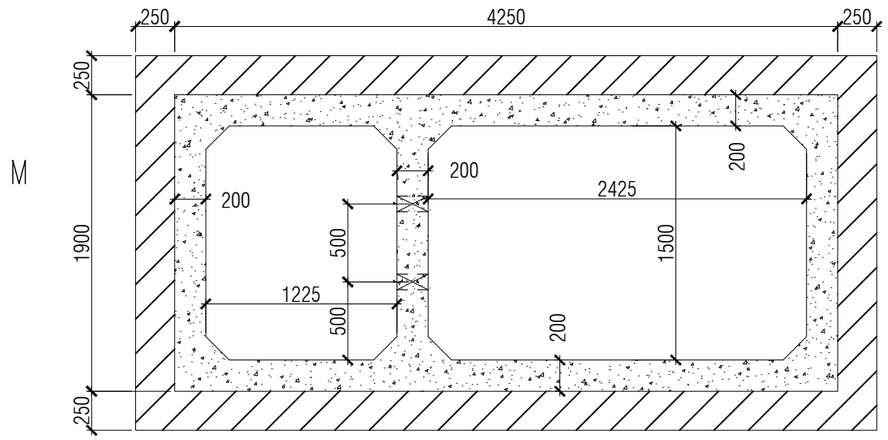
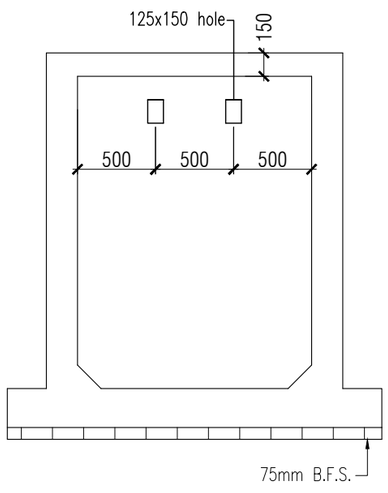
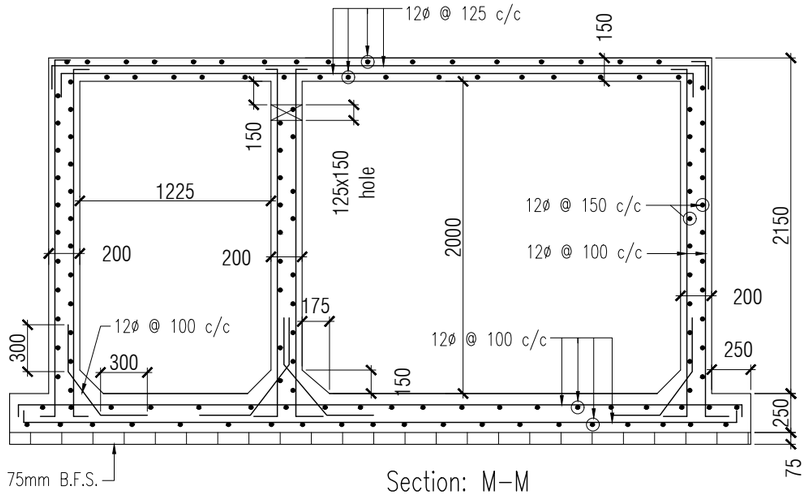


Plan of Septic Tank

N



Section: N–N

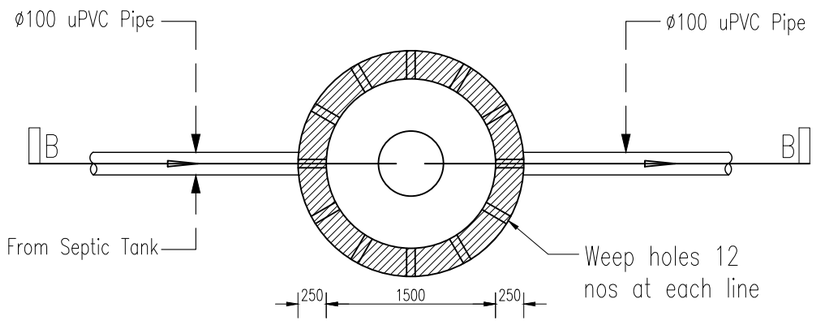


Section: M–M

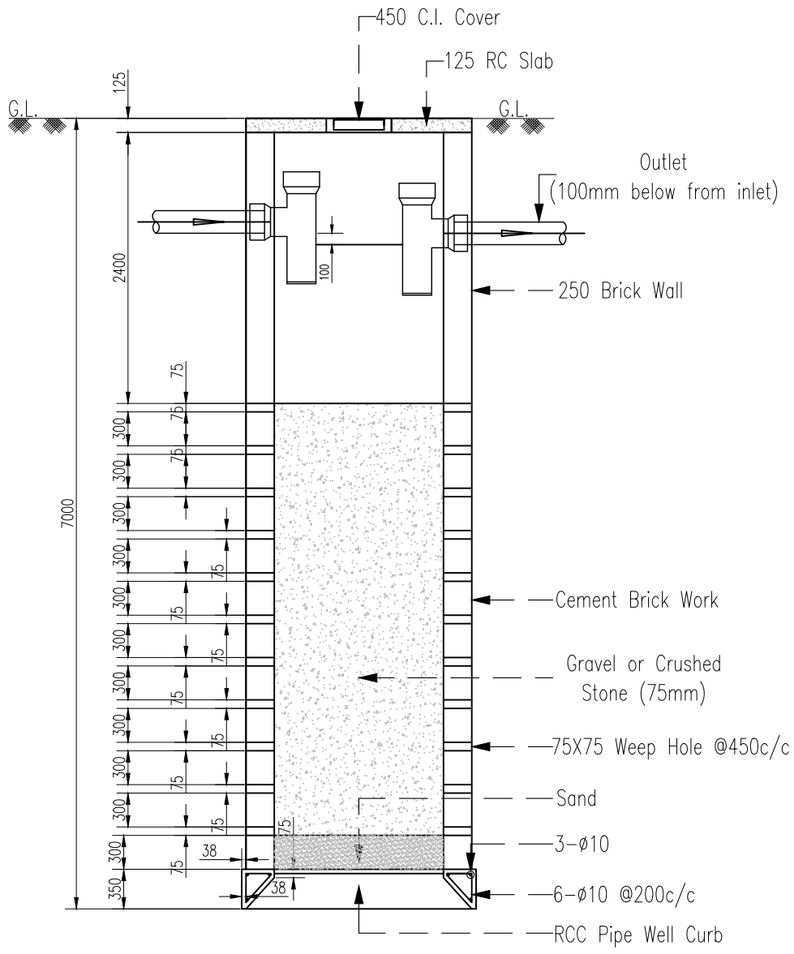
SEPTIC TANK DETAILS

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility	Revision History:	
			SHEET TITLE: Details of Septic Tank	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-07-D-07

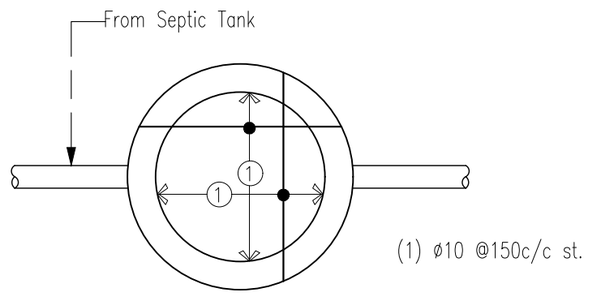
TENDER DRAWINGS



Soakwell



Section B-B



Reinforcement Detailing of Soakwell

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing, Sanitary and Drainage Design of the Winch Control Facility SHEET TITLE: Details of Soakwell CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-07-D-08

TENDER DRAWINGS

LEGEND

DATA CABLE SOCKET/IT SOCKET

INTERCOM

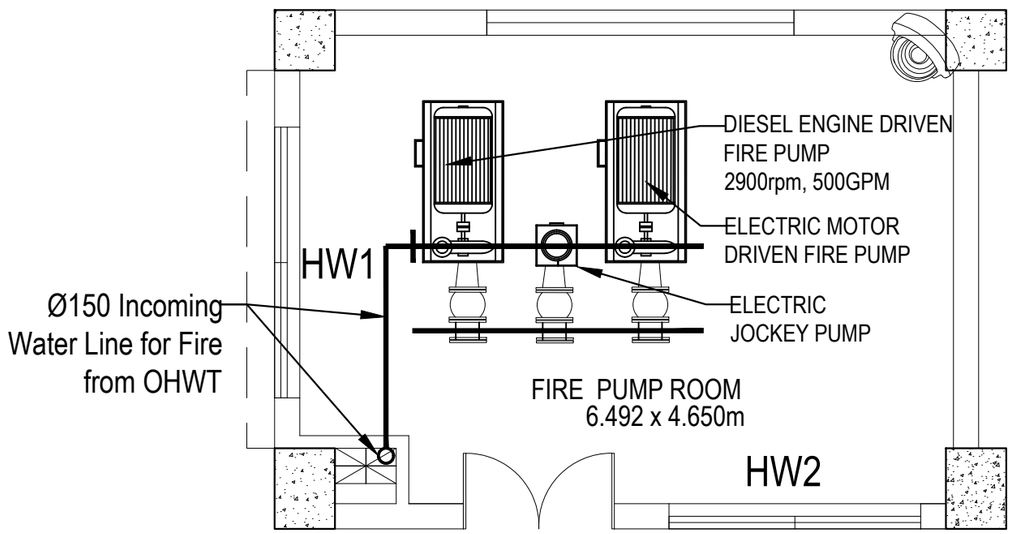
WiFi Access Point

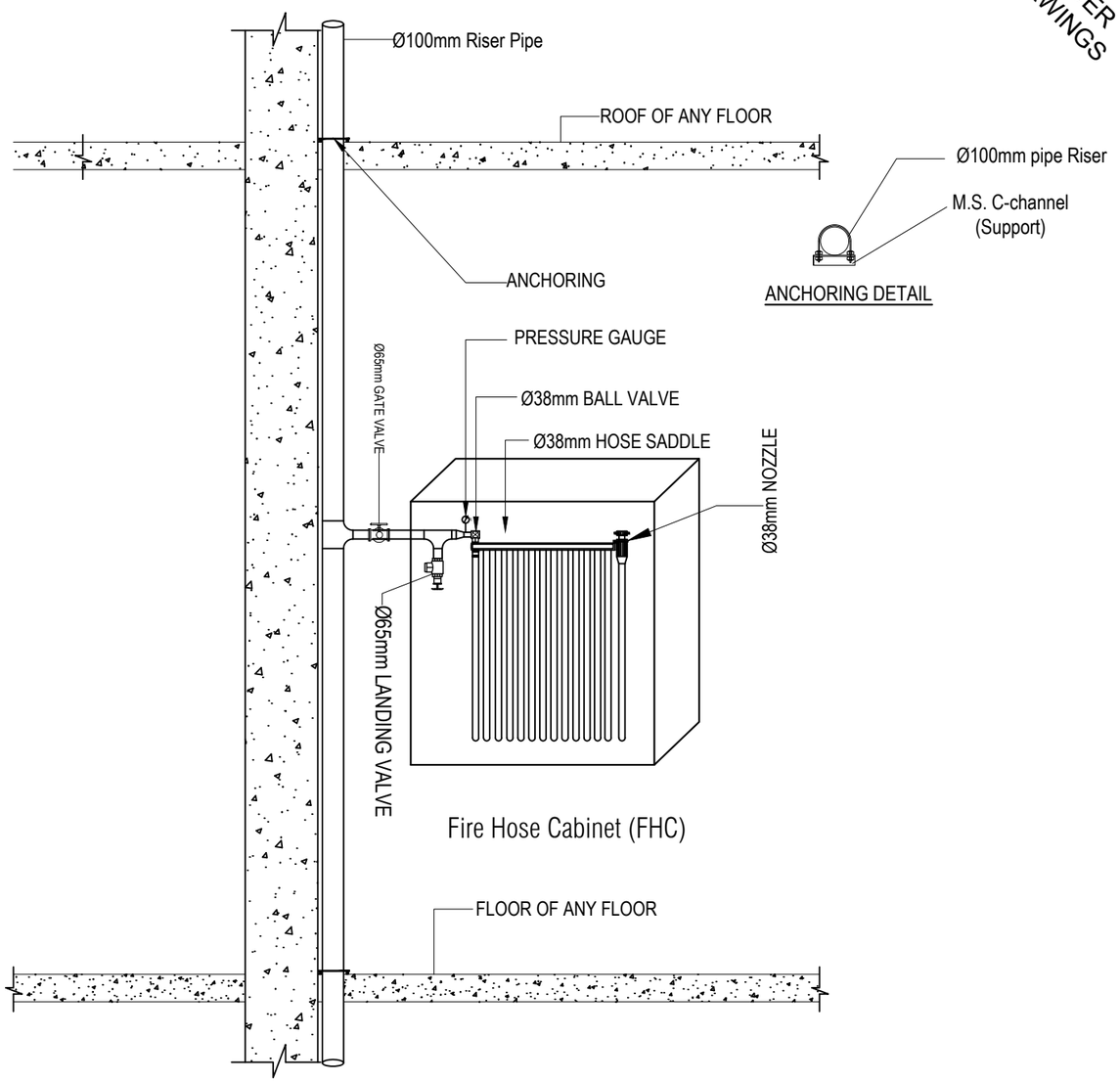
INS: INTERNET NETWORK SWITCH

INDOOR TYPE 3MP CCTV

Notes:

Suction Ø150mm Pipe from BNS Mongla base reserve
Delivery Header Ø200mm Pipe from UGWR bottom level
Ø100mm Pipe for Riser with Fire Hose Cabinet: Class-III
Ø100mm Pipe for Pillar Hydrant





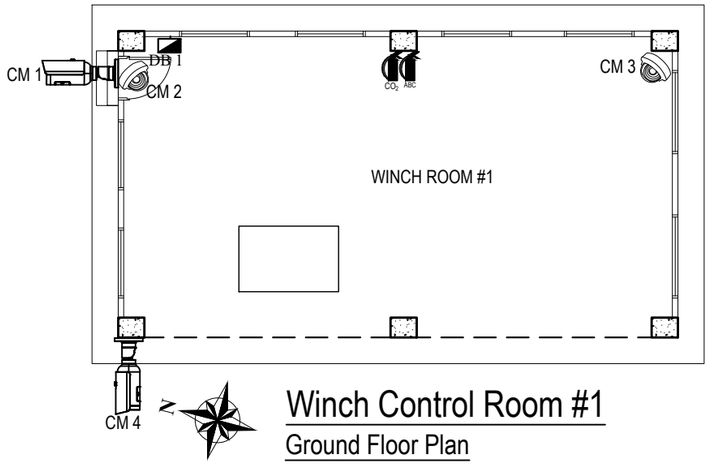
Detail Connection of
Fire Hose Cabinet (FHC)

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Fire, CCTV and Telecommunication Design of Winch Control Facility SHEET TITLE: Fire, CCTV, Internet and Intercom Legend Typical plan of Fire Hydrant Room Schematic View of Fire Hose Cabinet CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN

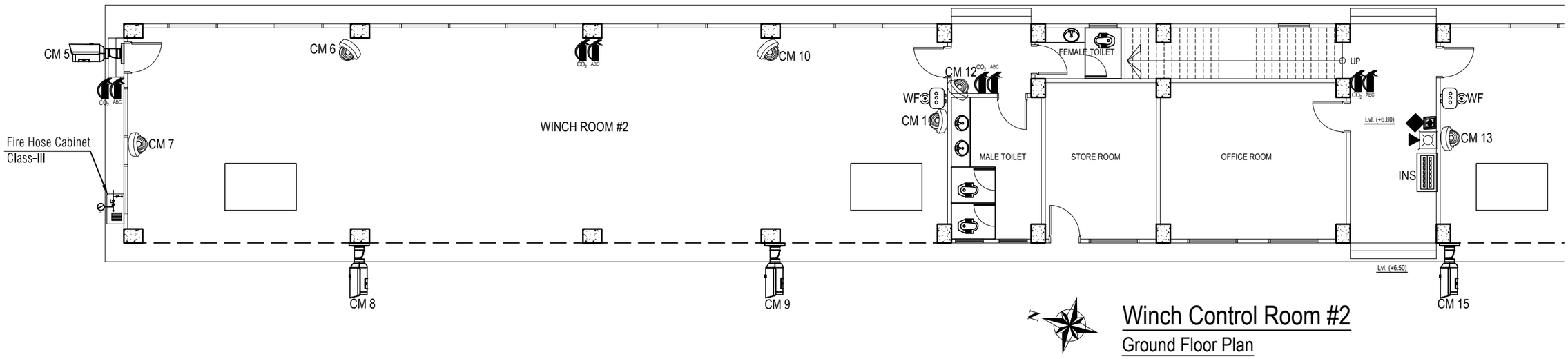
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:

Drg No. D-07-E-001

TENDER DRAWINGS



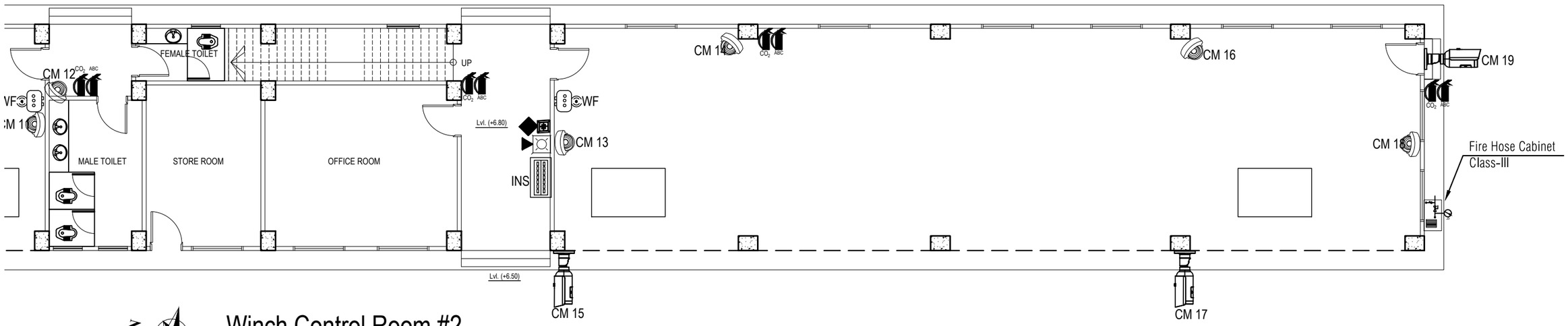
Winch Control Room #1
Ground Floor Plan



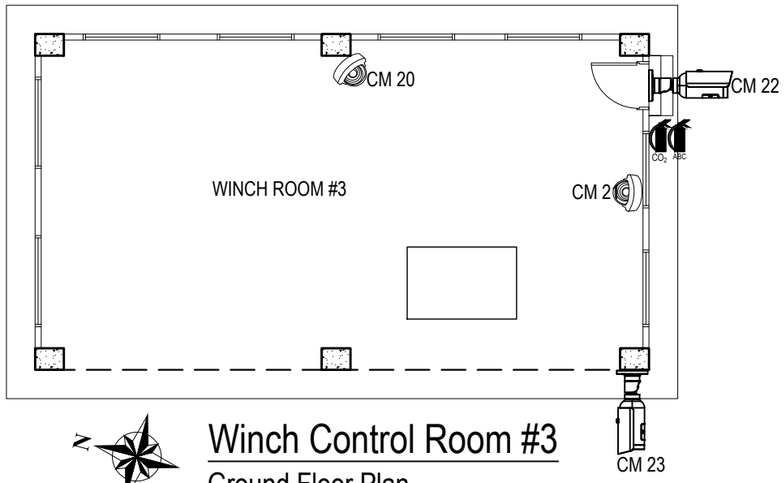
Winch Control Room #2
Ground Floor Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Fire, CCTV and Telecommunication Design of Winch Control Facility SHEET TITLE: Fire & CCTV, Internet and Intercom Fixture Layout, Winch Control Room # 01 CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-07-E-002	 Date: 30-Apr-2025 Status: Revision:

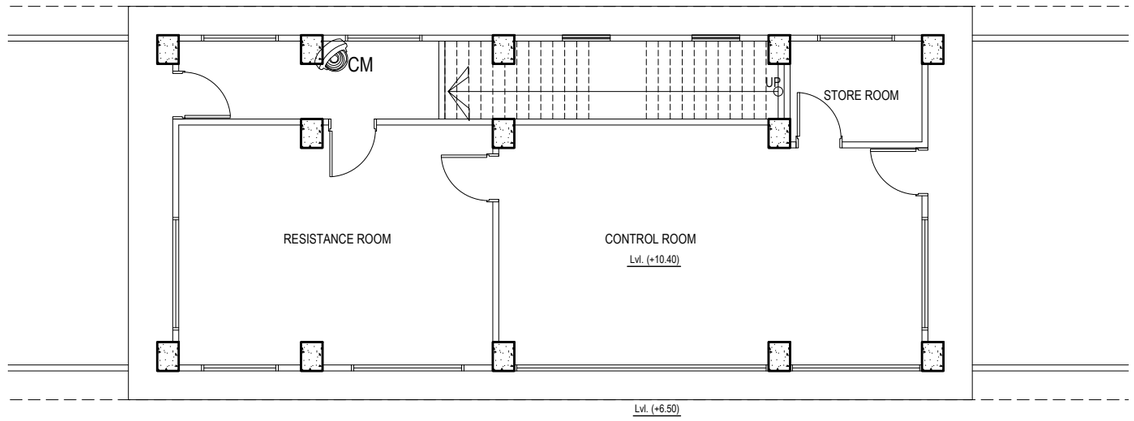
TENDER DRAWINGS



Winch Control Room #2
Ground Floor Plan



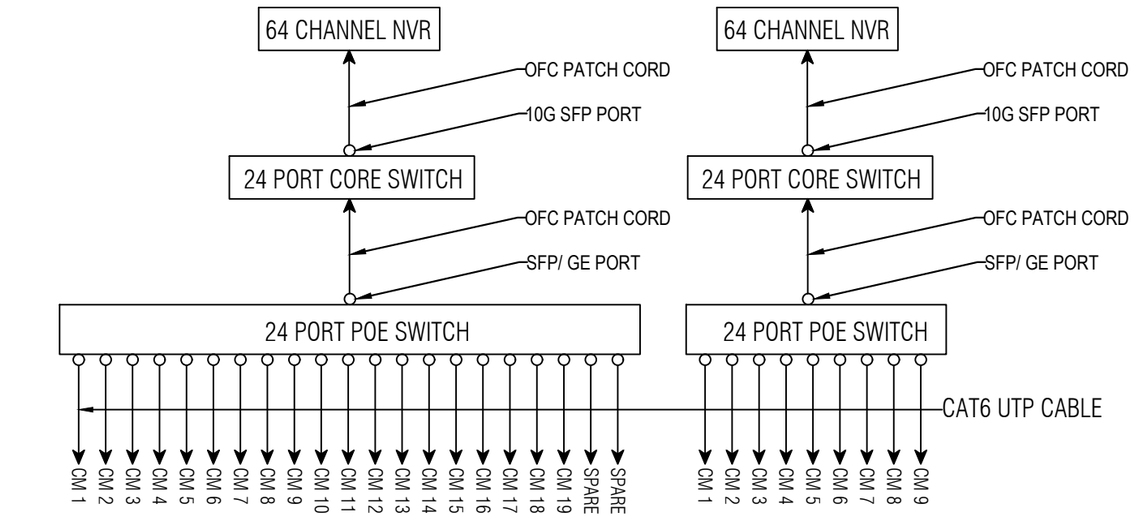
Winch Control Room #3
Ground Floor Plan



Winch Control Room #2
1st Floor Plan

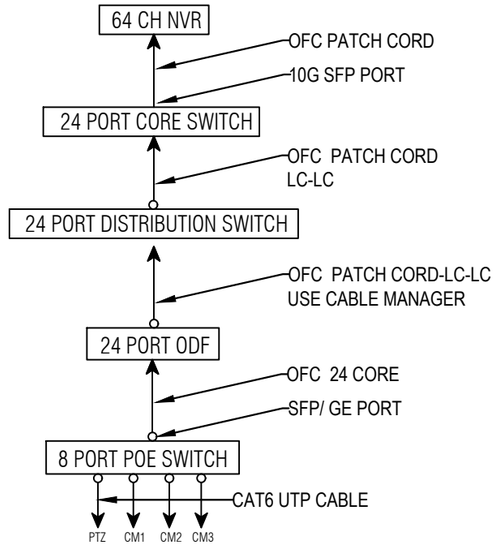
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.
DRG. TITLE: Fire, CCTV and Telecommunication Design of Winch Control Facility	Revision History:	
SHEET TITLE: Fire & CCTV, Internet and Intercom Fixture Layout, Winch Control Room # 02 and 03	1.	Date: 30-Apr-2025
	2.	Status:
	3.	Revision:
CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-07-E-003	

TENDER DRAWINGS

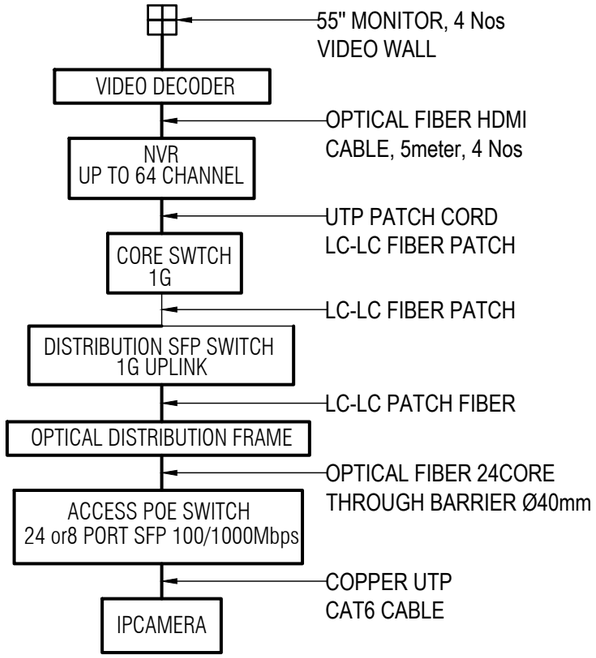


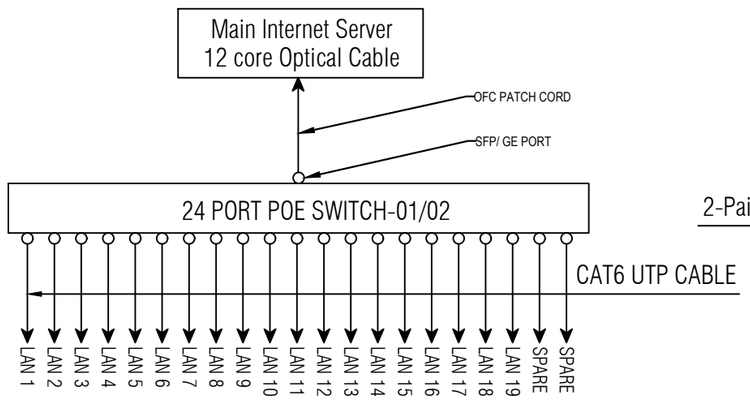
Single Line Diagram, Ground Floor Network Switch

Single Line Diagram,
1st Floor Network Switch

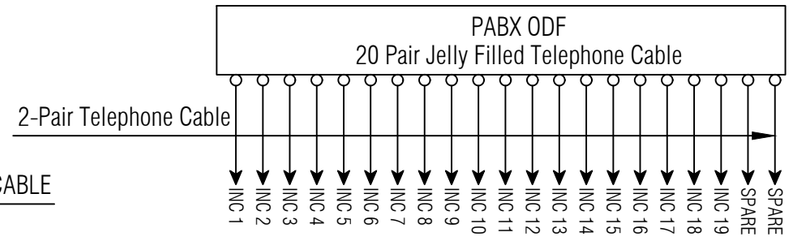


Single Line Diagram,
Open Yard Network Switch





Single Line Diagram, 1st Floor Network Switch-01 and 02



Single Line Diagram, 1st Floor, TDF-01 & TDF-02

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Fire, CCTV and Telecommunication Design of Winch Control Facility SHEET TITLE: Single Line Diagram for CCTV, Internet and Intercom System CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:
Drg No. D-07-E-004		

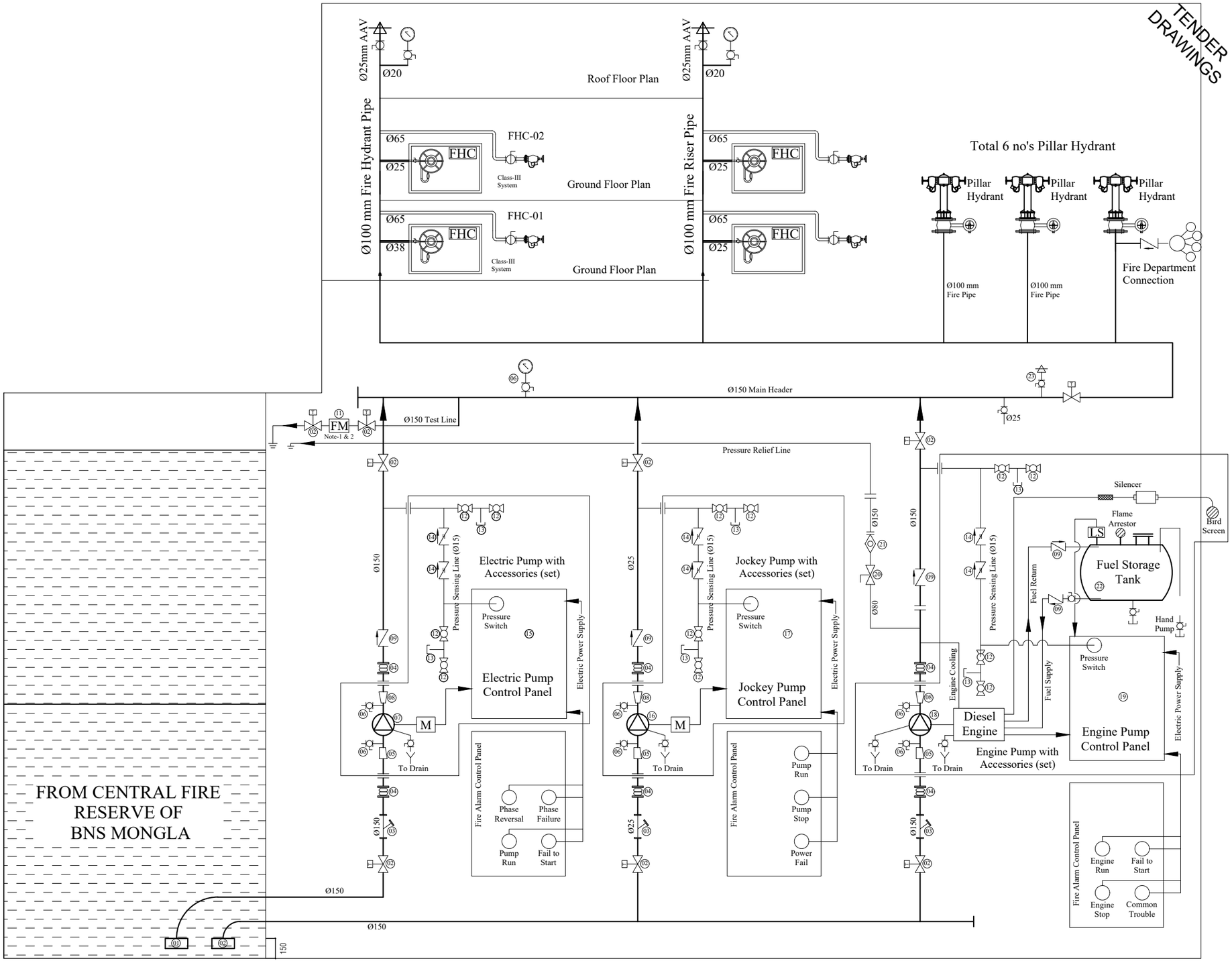
Equipment Description	
Sl No.	Description
01	Anti-vortex Plate
02	OS & Y Gate Valve with Temper/ Supervisory Switch
03	Y-Strainer
04	Flexible Joint
05	Eccentric Reducer
06	Pressure Gauge with ball Valve
07	Electric Motor Driven Pump
08	Concentric Reducer
09	Non-return Valve
10	OS & Y Gate Valve
11	Water Flow Meter
12	Globe Valve with Cap
13	Tee with Plug
14	Orifice Clapper Valve
15	Electric Pump Control Panel
16	Electric Motor Driven Jockey Pump
17	Jockey Pump Control Panel
18	Diesel Engine Driven Pump
19	Diesel Engine Pump Control Panel
20	Pressure Relief Valve
21	Waste Cone
22	Fuel Storage Tank with Accessories
23	Automatic Air Release Valve
24	Flow Switch

Notes:
1. Metering Device shall be Capable of Water flow not less than 175% of Rated Pump Capacity.

2. The installation of Pumps shall be fabricated, installed, tested and placed according to NFPA-20

Sequence of Operation for Fire Pumps and Jockey Pump:

Pumps	Rated Flow & Pressure
Electric Motor Driven Jockey Pump (Make-up Pump)	25 GPM & 159.5 psi
Electric Motor Driven Fire Pump (Duty Pump)	500 GPM & 159.5 psi
Diesel Engine Driven Fire Pump (Standby Pump)	500 GPM & 159.5 psi



PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Fire, CCTV and Telecommunication Design of Winch Control Facility SHEET TITLE: Riser Diagram of Fire Protection System CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: Drg No. D-07-E-005

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

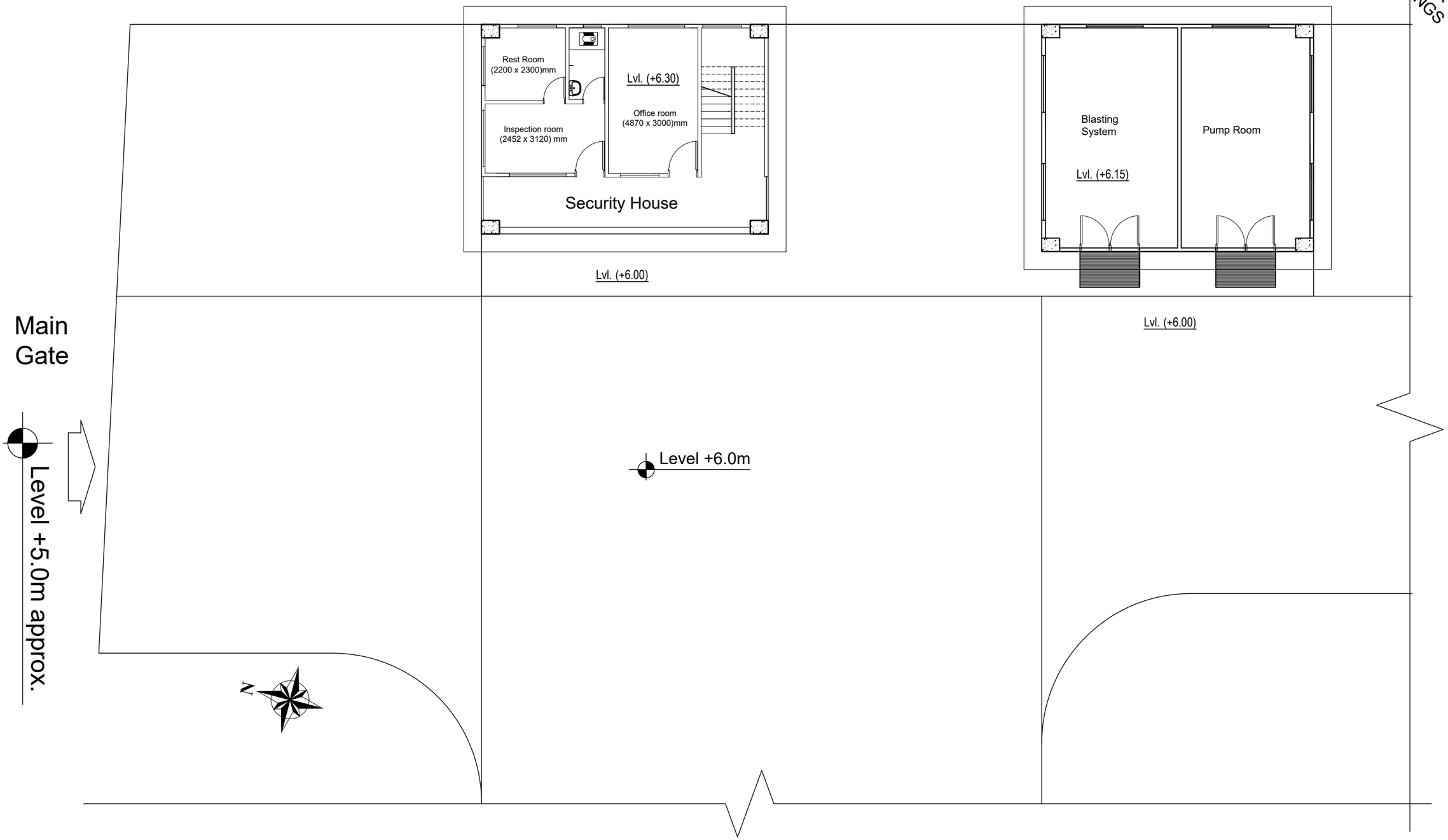
Security House, Pump & Blasting System Design

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTANT (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

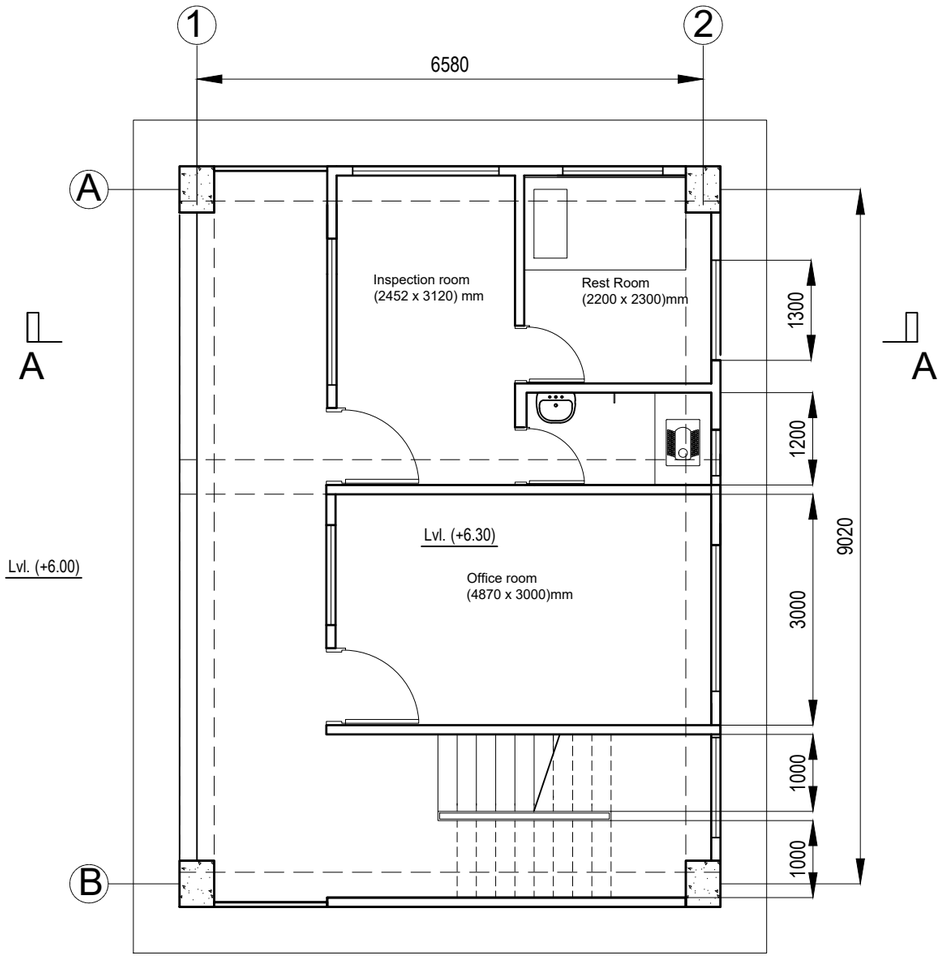
TENDER DRAWINGS



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Typical Layout Plan SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-A-001

Date: 30-Apr-2025
Status:
Revision: R-00

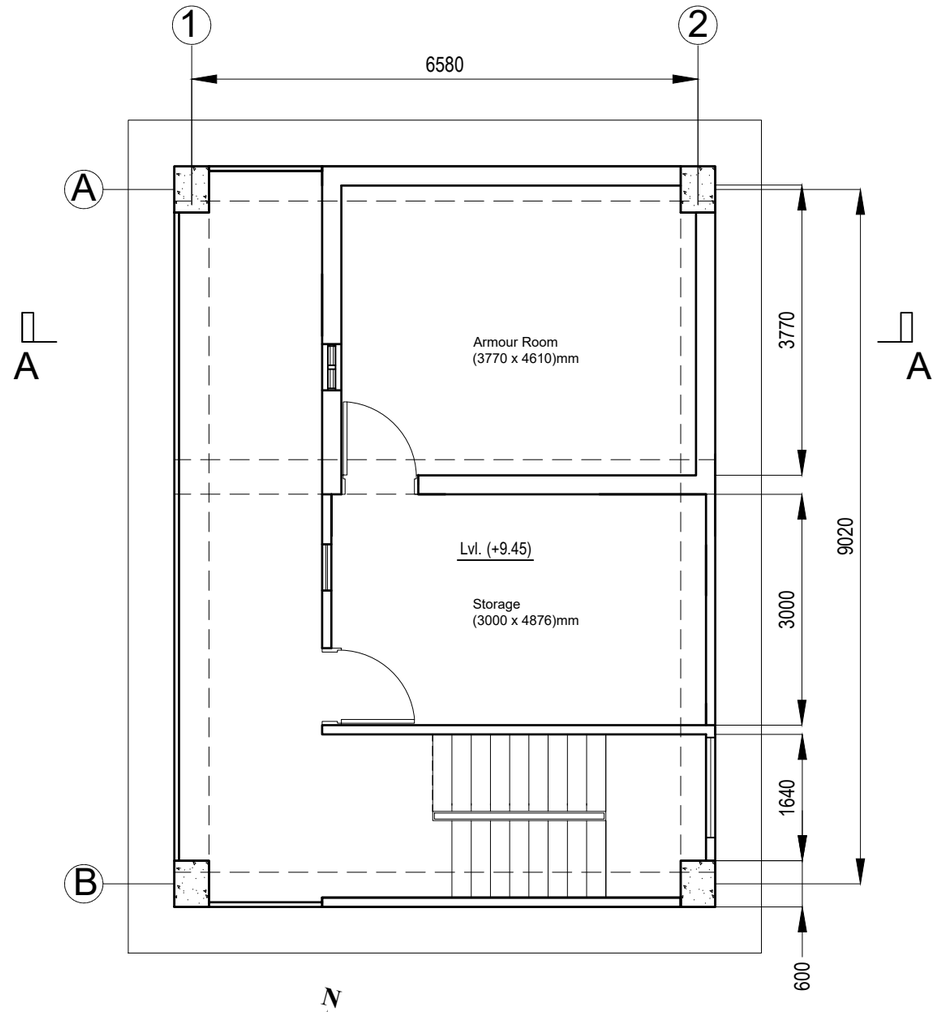
TENDER DRAWINGS



N

Ground Floor Plan

Security House



N

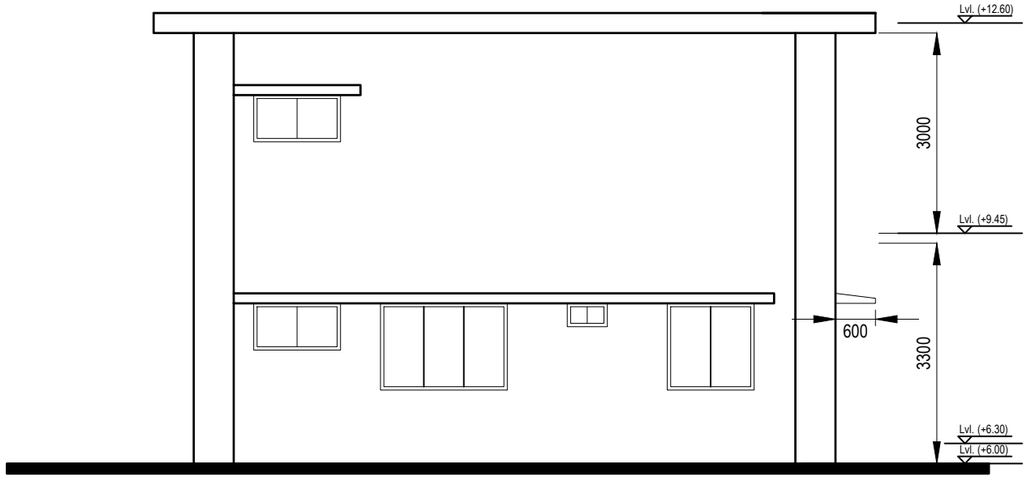
First Floor Plan

Security House

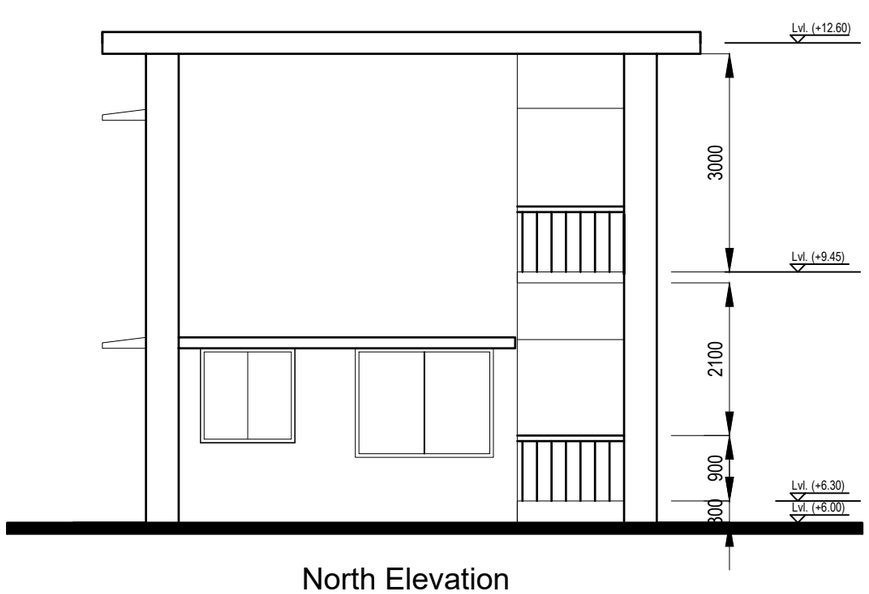
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Security House Floor Plan SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-A-002 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

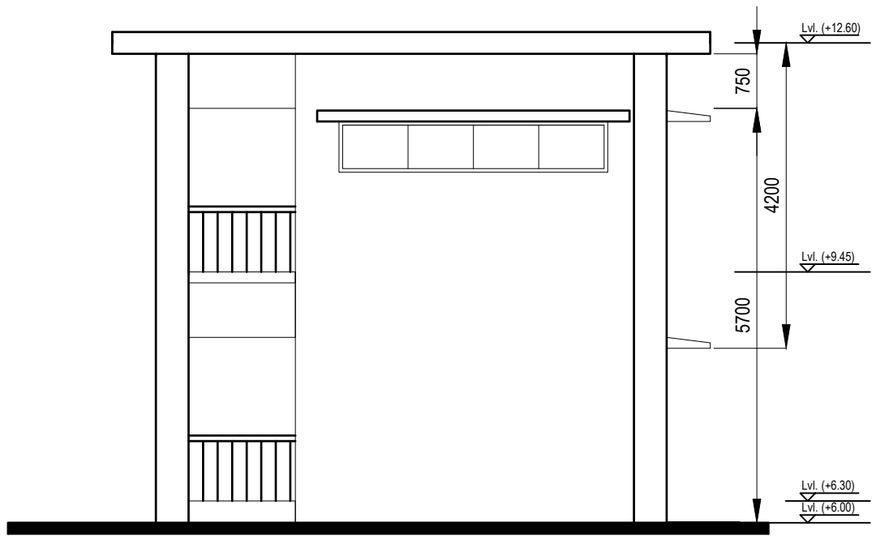
East Elevation



West Elevation



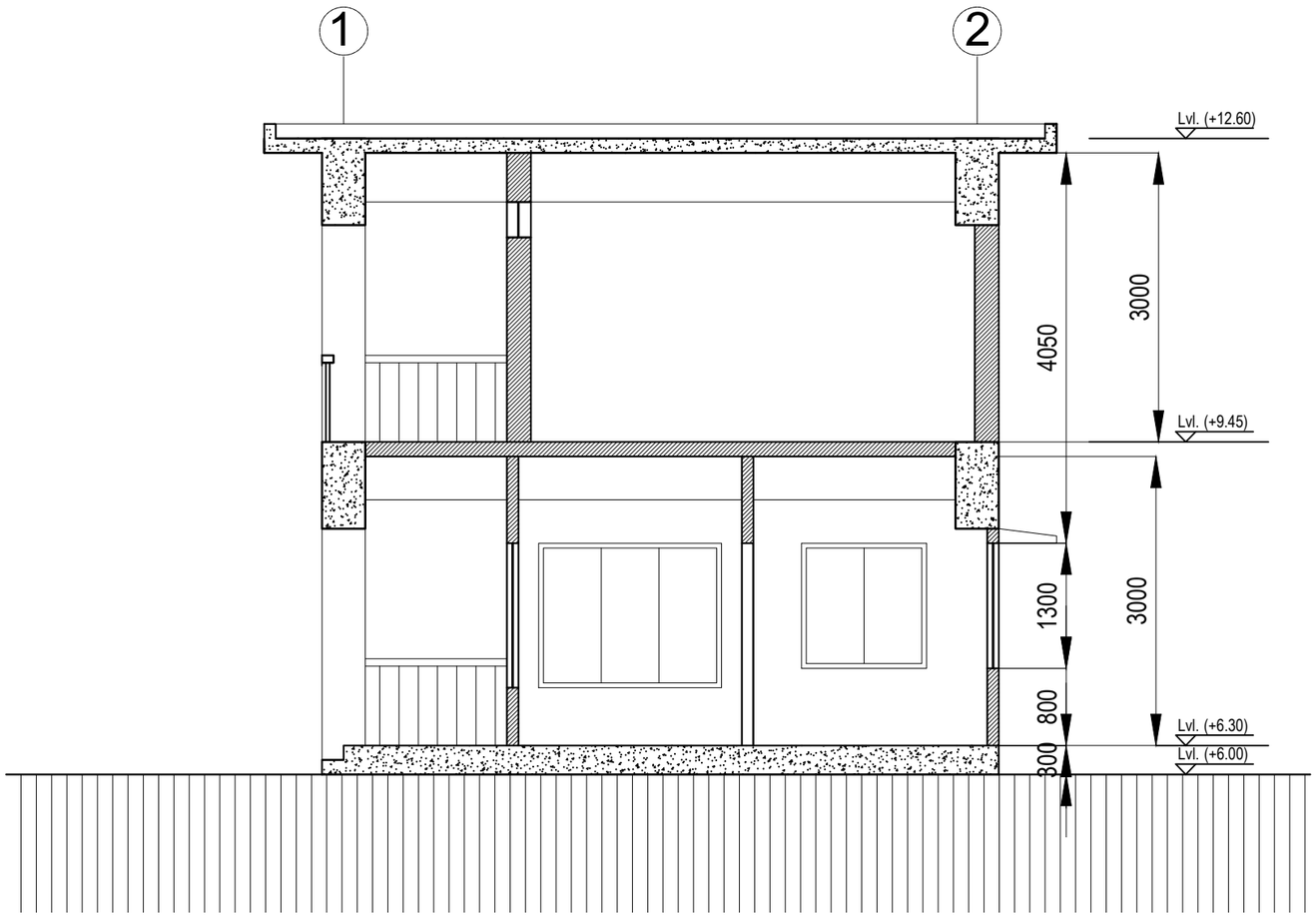
North Elevation



South Elevation

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Elevation Drawings SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-A-003
				Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS

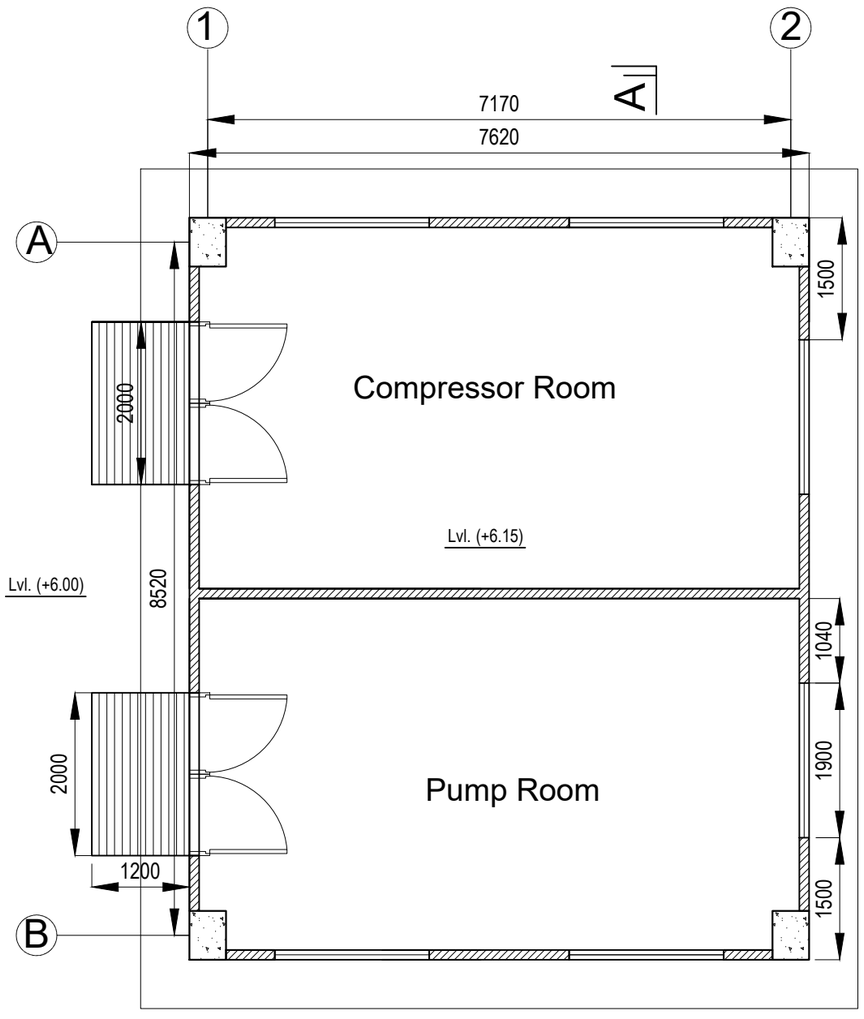


Security House

Section A-A

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Section Drawing SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-A-004	 Date: 30-Apr-2025 Status: Revision:

TENDER DRAWINGS



A

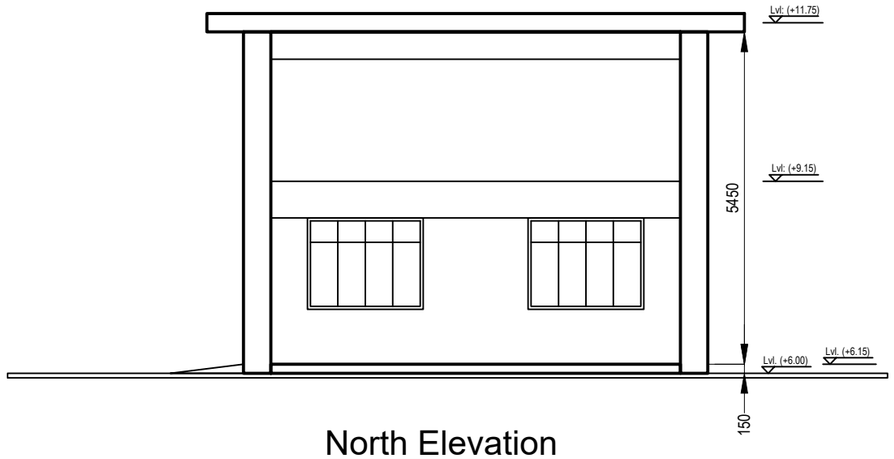
N

Ground Floor Plan

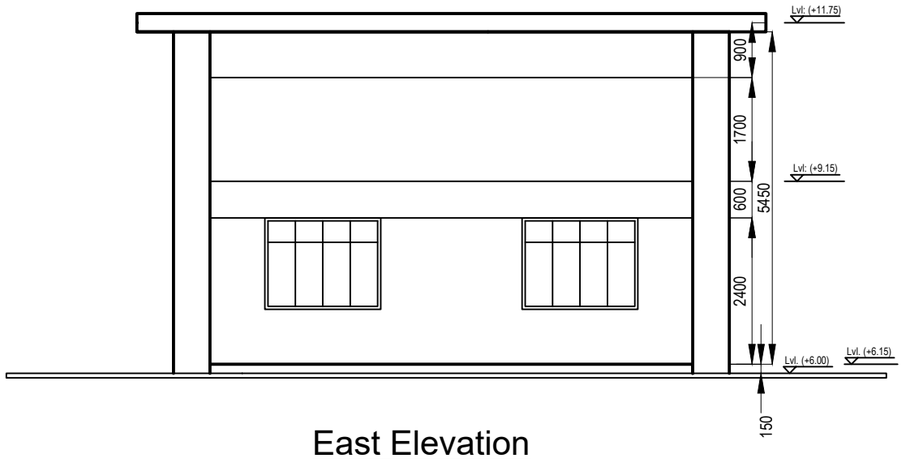
Pump & Blasting System

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Security and Blasting System Room Floor Plan SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: Drg No. D-08-A-005

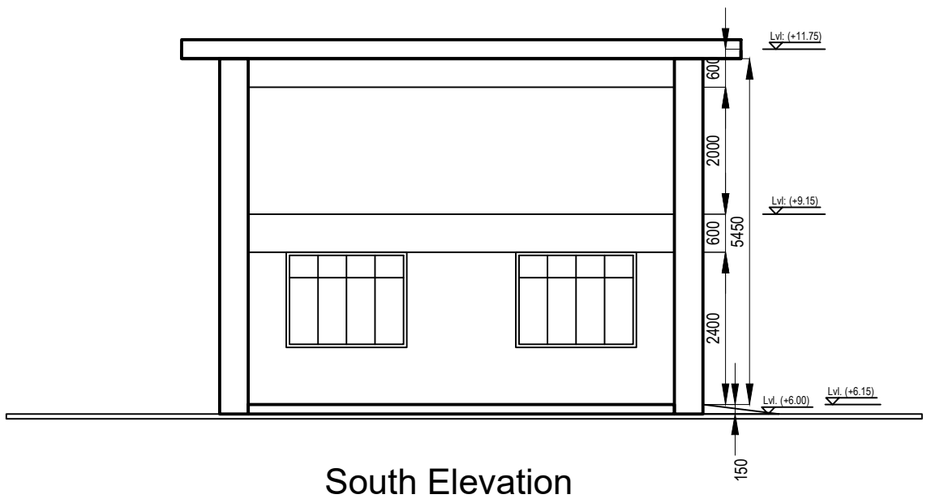
TENDER DRAWINGS



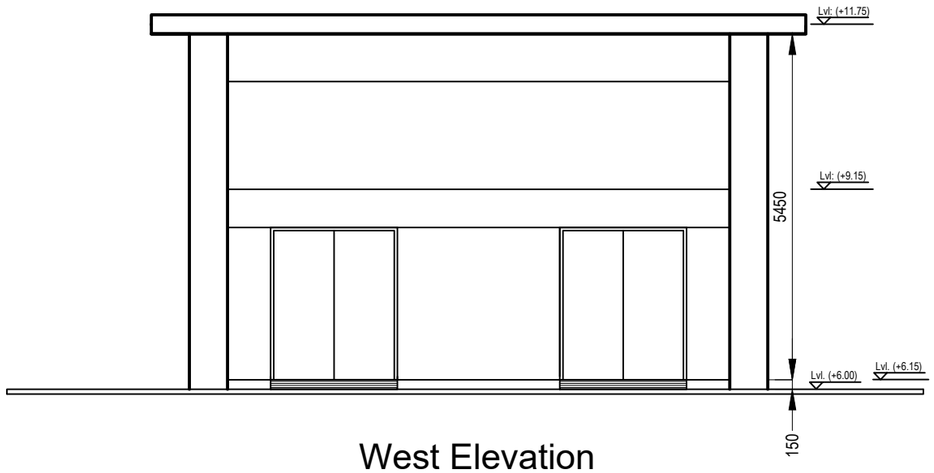
North Elevation
Pump & Blasting System



East Elevation
Pump & Blasting System



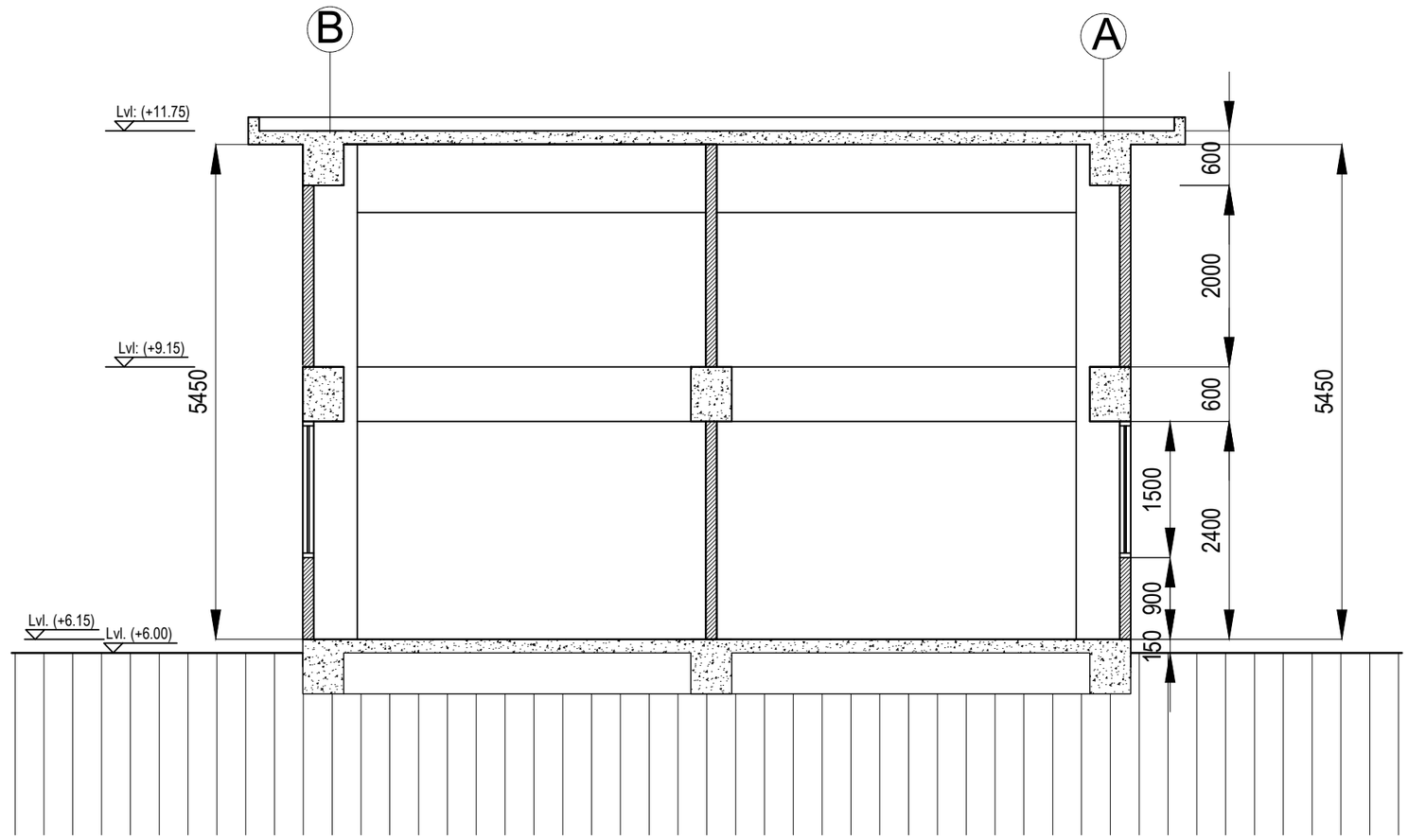
South Elevation
Pump & Blasting System



West Elevation
Pump & Blasting System

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System SHEET TITLE: Security and Blasting System Room Elevation Drawings SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-08-A-006

TENDER DRAWINGS



Pump & Blasting System

Section A-A

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Security and Blasting System Room Section Drawing	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision:
			SCALE: AS SHOWN	Drg No. D-08-A-007	

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M.≥0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:
			SHEET TITLE: General Notes for Reinforced Concrete Items - 1 of 5	1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-08-B-001

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

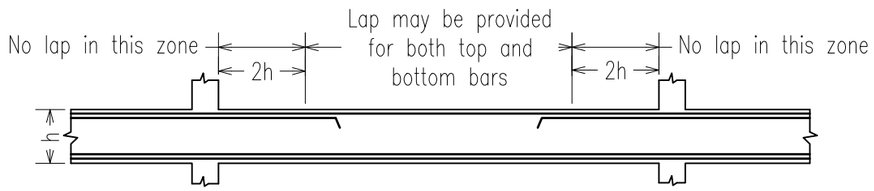
Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

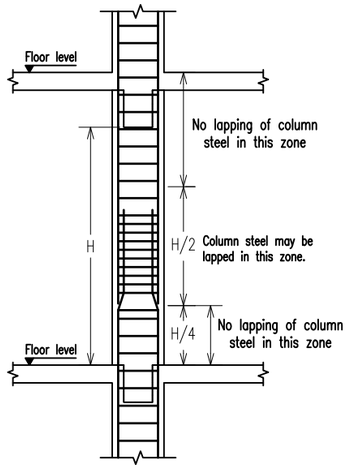
Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

7. LAP SPLICE LOCATION IN BEAMS



Not more than 50% of the bars shall be spliced at one place of the beam. Lap splices are to be confined by hoops/stirrups with maximum spacing of 100mm.

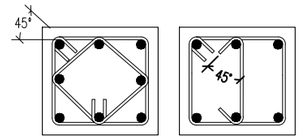
8. LAP SPLICE LOCATION IN COLUMNS



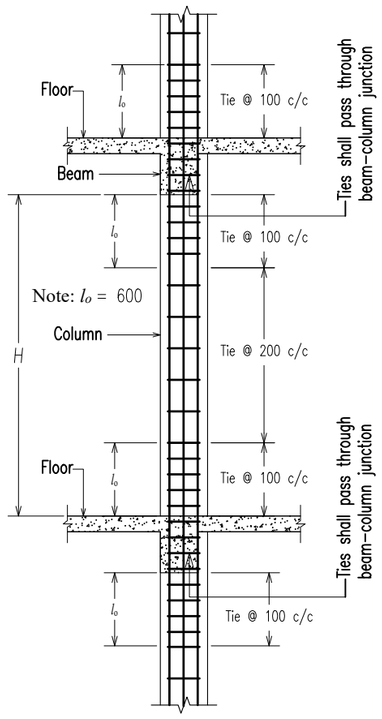
Lap splices are to be confined by hoops/ties with maximum spacing of 125mm.

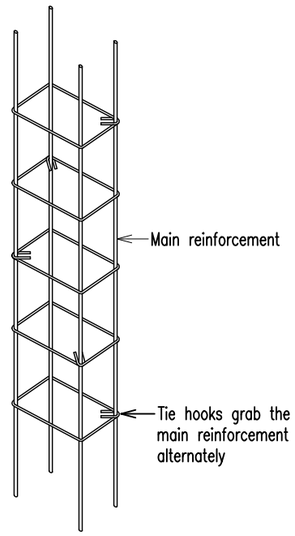
9. COLUMN TIE DETAILS

a. Hook's of column ties:
Hooks of column ties shall be bent 45° inwards and length of the hook shall be minimum 75mm as shown below. Ties shall be arranged such that corner hooks grab the main reinforcement in alternate fashion. Tie spacing shall be in accordance with that shown in fig below.



b. Spacing of column ties in buildings:
Spacing of column ties shall be as shown in fig below.





Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: General Notes for Reinforced Concrete Items - 2 of 5	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-002

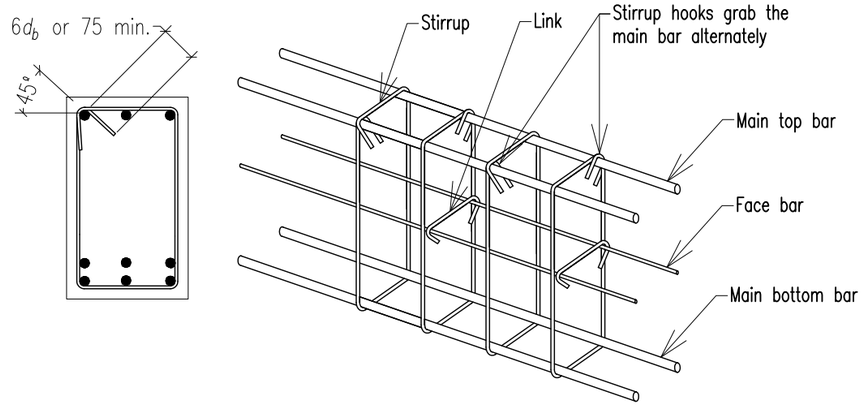
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

10. BEAM STIRRUP

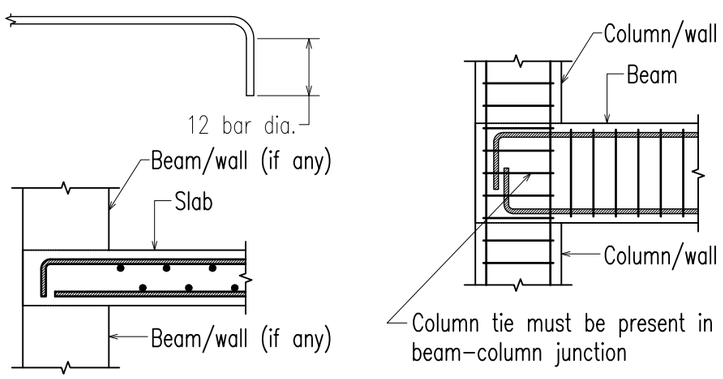
Hooks in beam stirrups shall be bent 45° inwards and length of the hook shall be minimum 3" (75mm) as shown below. Stirrups shall be arranged such that corner hooks grab the main reinforcement in alternate fashion.



11. END ANCHORAGE FOR HORIZONTAL REINFORCEMENT (IN BEAM, SLAB, MAT ETC).

90° hooks shall be provided for i) all main bars of beams (top and bottom) which terminate into column or walls or other beams. ii) slab top bars terminating into supporting beams or walls. iii) mat reinforcement terminating at the periphery.

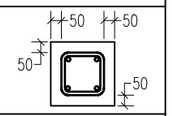
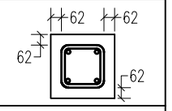
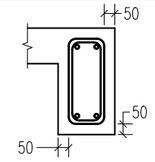
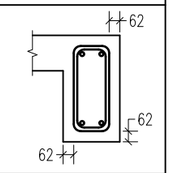
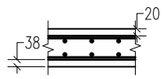
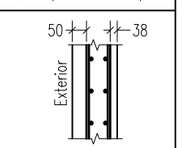
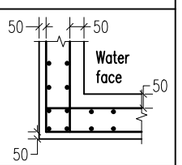
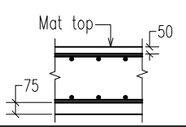
For all cases, the length of the hook shall be 12 times the bar diameter ($12d_b$).



Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

12. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Column, lift core and shear wall	Above ground level	50mm	
	Below or in contact with ground	62mm	
Beam	Top, side & bottom	50mm	
	Water face inside water tank side & bottom, below or in contact with ground	62mm	
Slab and stair	Top and bottom	20mm and 38mm	
R.C.C wall below ground	Exterior	50mm	
	Interior	38mm	
Water tank	Water face	50mm	
	Other face	50mm	
Footing and Mat foundation	Top	50mm	
	Bottom	75mm	

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: General Notes for Reinforced Concrete Items - 3 of 5 CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-08-B-003

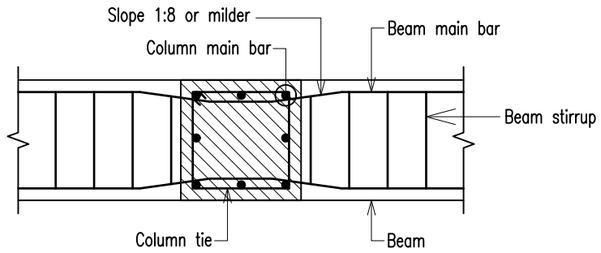
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

13. AVOIDING CONFLICT BETWEEN BEAM AND COLUMN REINFORCEMENT

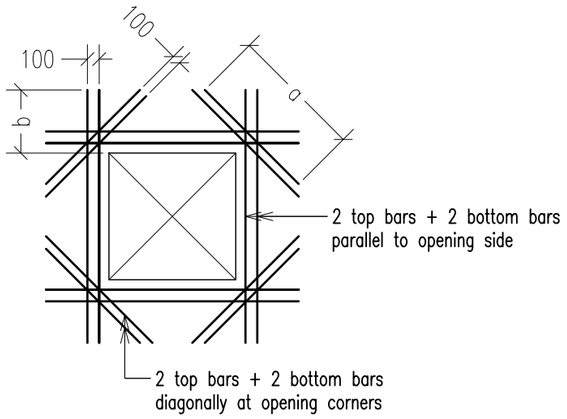
If conflict arises between beam and column or wall reinforcement when beam steel enters or passes through column, the beam reinforcement may be horizontally bent inwards into the column as shown in the following figure.



PLAN SECTION OF BEAM COLUMN JOINT

14. REINFORCEMENT DETAILING AROUND VOID/OPENING

Reinforcement details around void/opening in floor slabs shall be as shown in figure below. The detailing is valid for maximum void size of 900x900. For void/opening of larger size contact the consultant.

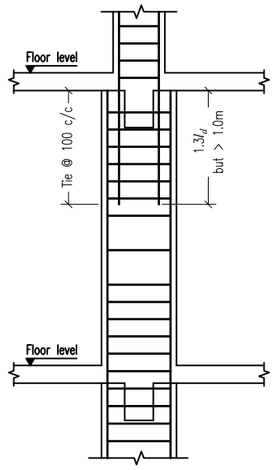


	Void/opening size less than 450	Void/opening size between 450 ~ 900
Dim. a	900	1500
Dim. b	600	900
Bar size	ø16	ø20

Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

15. COLUMN OFFSET DETAIL

When column size is reduced the transition of column main reinforcement from lower floor to upper floor shall be detailed as shown below.

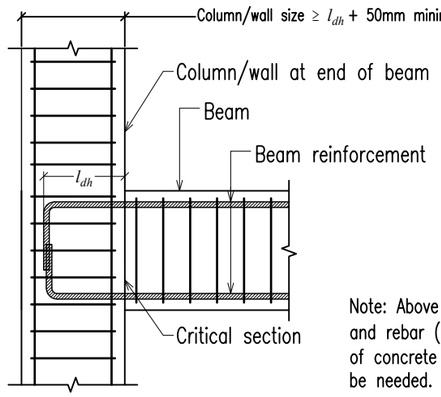


16. BRICK WORK

All brick work shall use first class brick or as specified by the consultant. Morter for brick work shall constitute 1:4 mix ratio (cement:sand). Morter for plastering work shall be 1:4 mix ratio (cement:sand).

17. END ANCHORAGE OF BEAM REINFORCEMENT

Minimum end anchorage length l_{dh} as shown below for different bar sizes must be maintained throughout.



fc' = 35 MPa, fy = 500 MPa	
Bar dia.	l_{dh}
mm	mm
10	150
12	150
16	225
20	300
25	425

Note: Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of embedment length shall be needed.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: General Notes for Reinforced Concrete Items - 4 of 5 CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN
			Revision History: 1. 2. 3. Drg No. D-08-B-004
			Date: 30-Apr-2025 Status: Revision: R-00

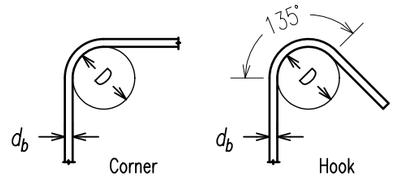
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

18. BAR BENDING PIN DIAMETER FOR HOOKS AND L-BENDS

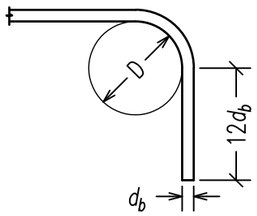
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement

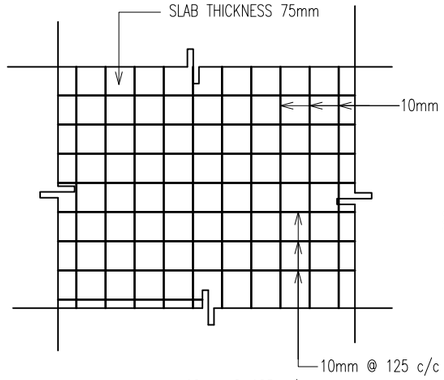


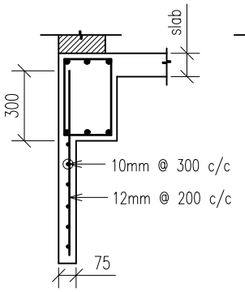
D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

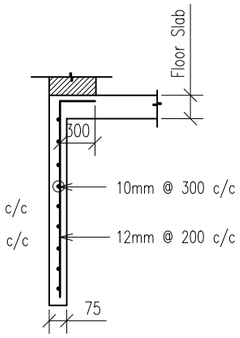
19. MISCELLANEOUS STRUCTURAL DETAILS

The miscellaneous details shown below shall be followed wherever applicable unless otherwise mentioned elsewhere.

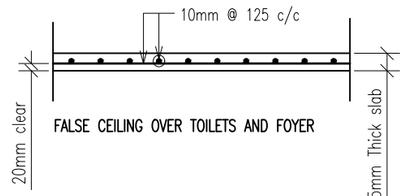




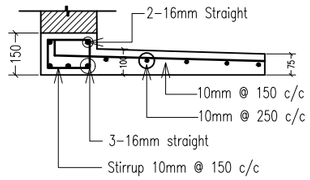
DROP PANEL: FROM BEAM



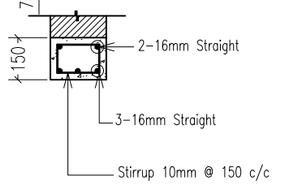
DROP PANEL: FROM SLAB



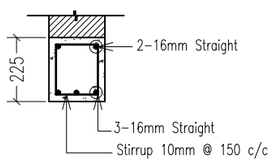
FALSE CEILING OVER TOILETS AND FOYER



WINDOW LINTEL WITH SUNSHADE



INTERIOR LINTEL (SPAN < 1.2m)

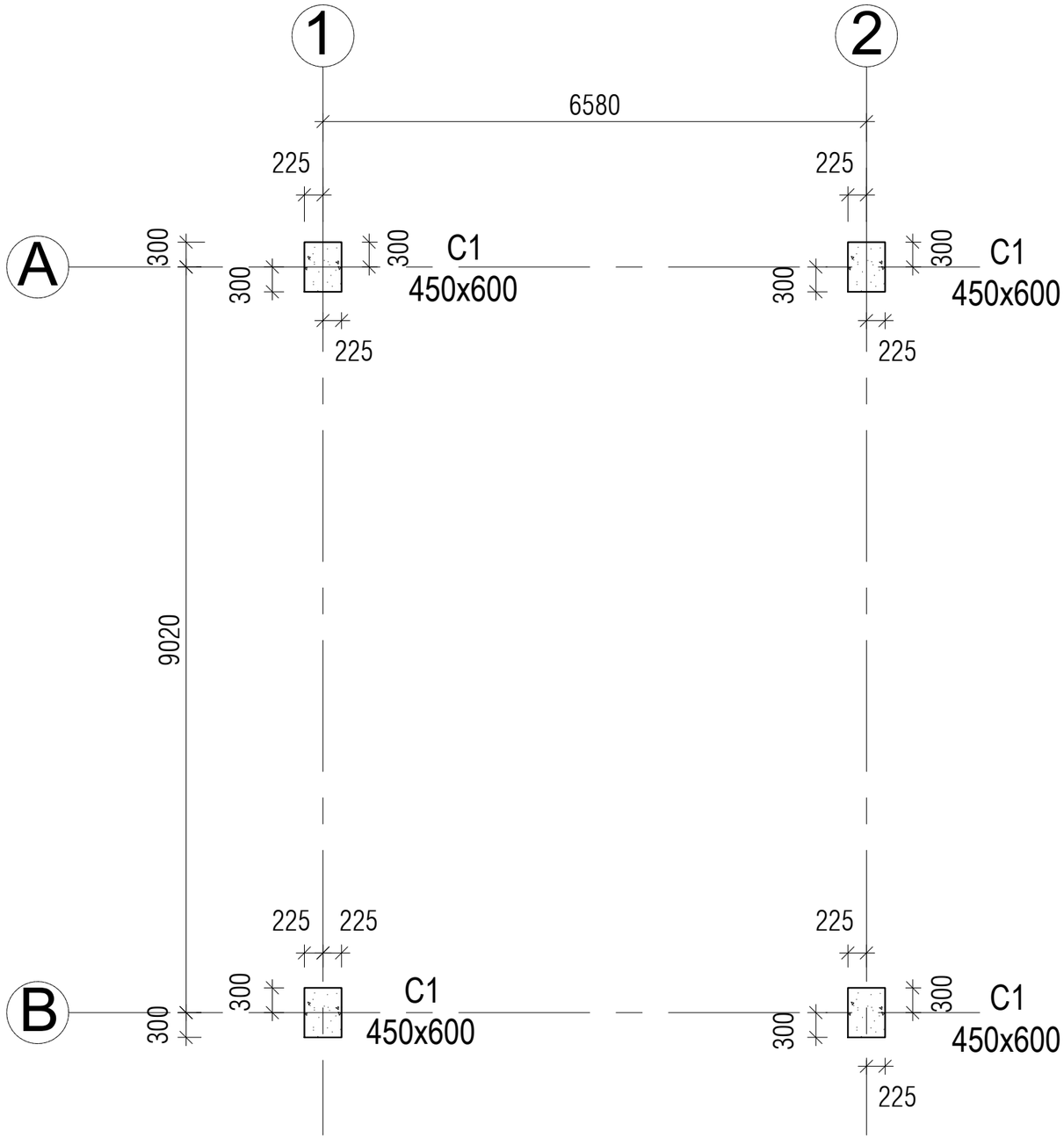


INTERIOR LINTEL (1.2m < SPAN < 2.4m)

Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:
			SHEET TITLE: General Notes for Reinforced Concrete Items - 5 of 5	1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-08-B-005

TENDER DRAWINGS



N

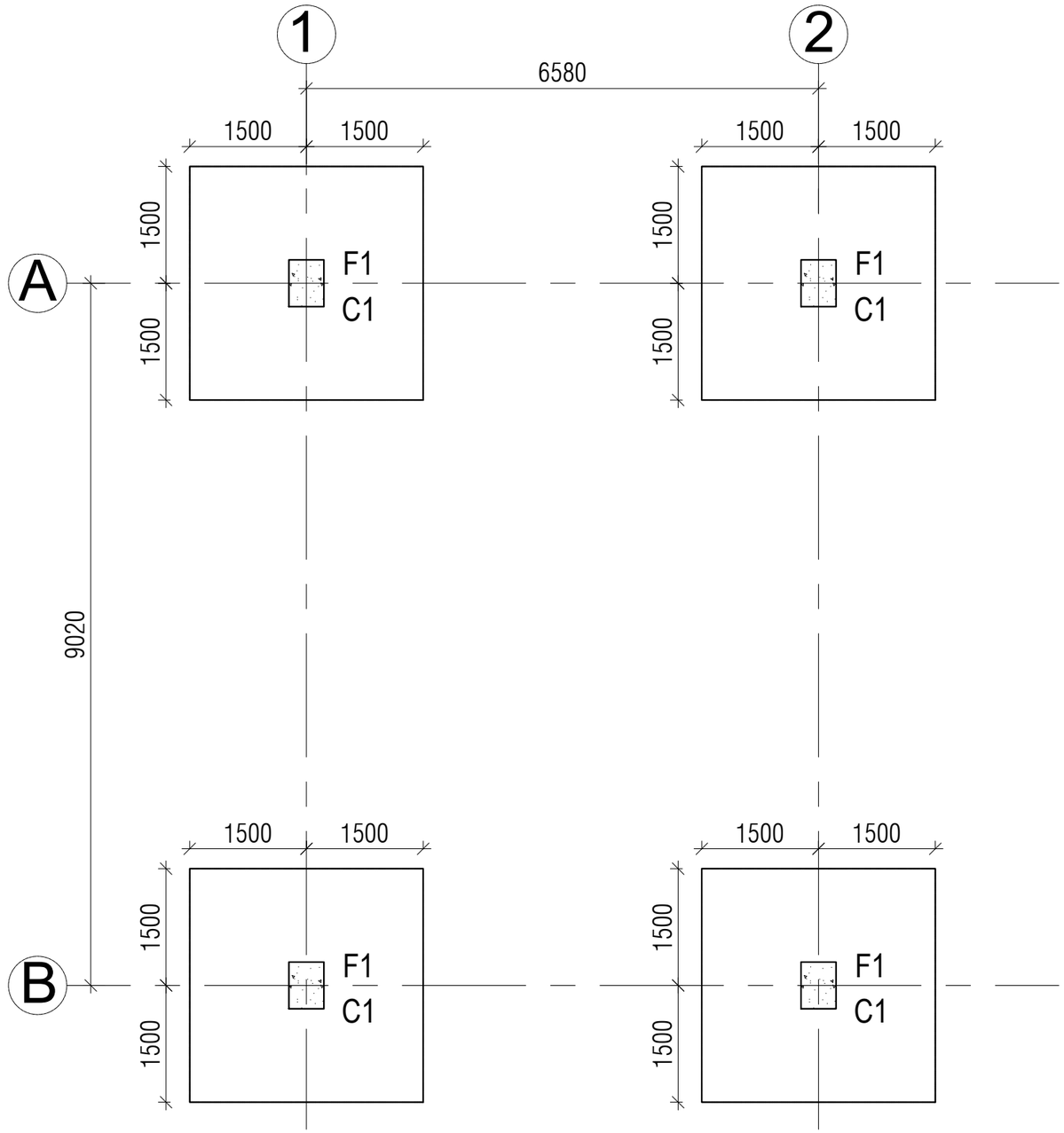
Column Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Column Layout Plan of Security House		1.
					2.
					3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-006

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



N

Footing Layout Plan

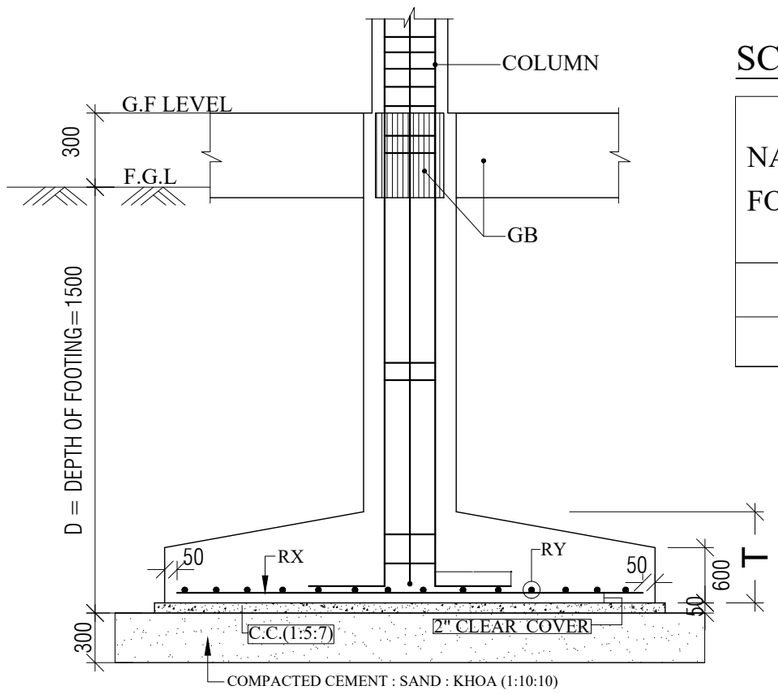
**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Footing Layout Plan of Security House CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-08-B-007

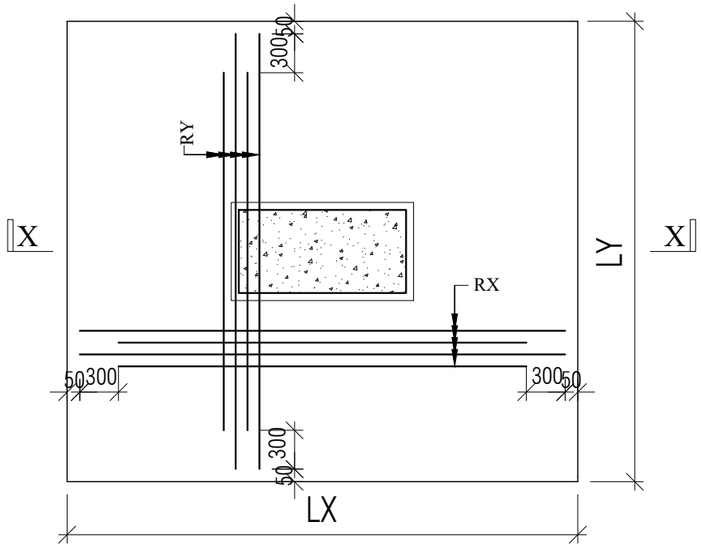
TENDER DRAWINGS



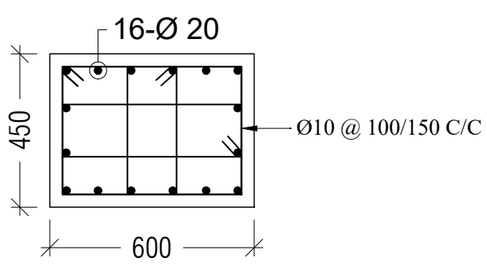
SECTION ON - X-X

SCHEDULE OF FOOTING :

NAME OF FOOTING	SIZE OF FOOTING		THICKNESS OF FOOTING	REINF. OF FOOTING.	
	LX	LY	T mm	Rx	Ry
F1	3000	3000	900	Ø16 @ 150 C/C	Ø16 @ 150 C/C



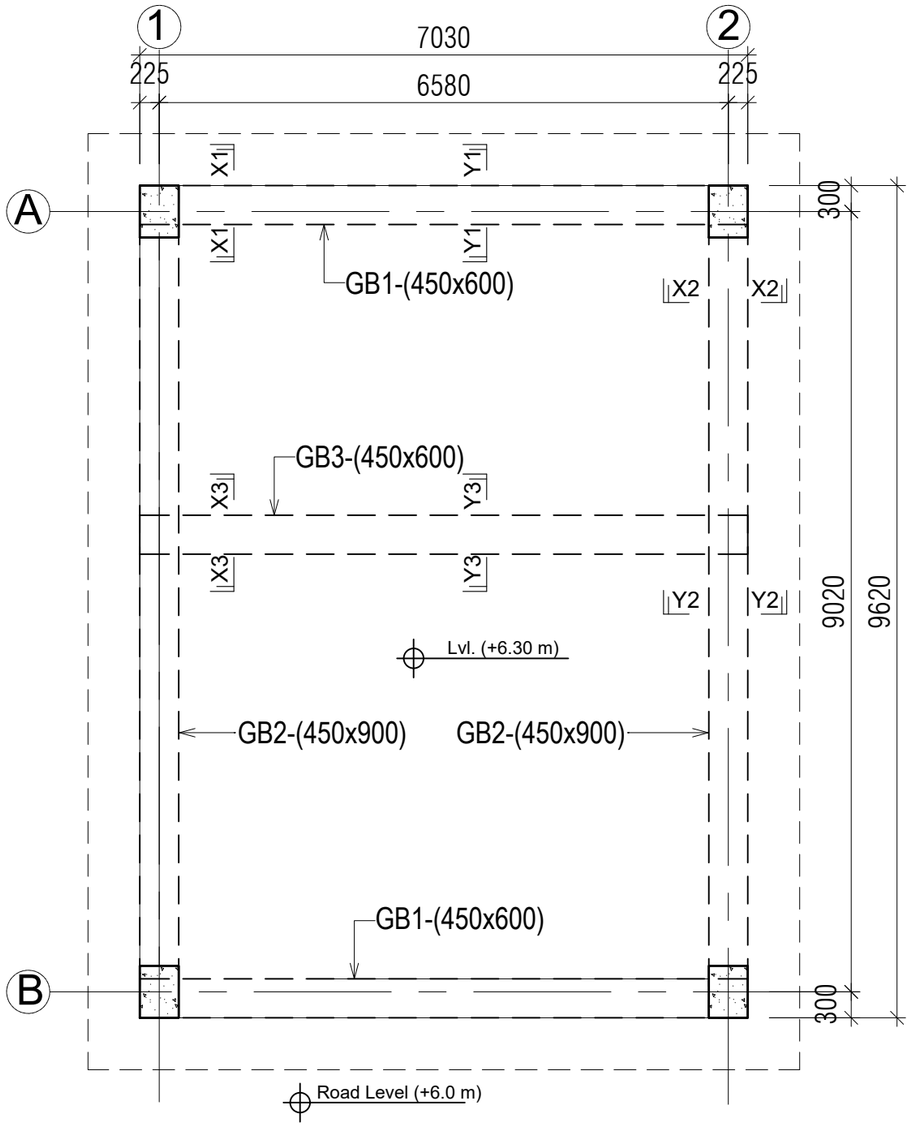
PLAN OF TYPICAL FOOTING



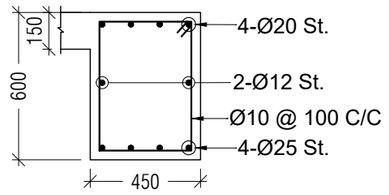
Column Section - C1

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Footing & Column Schedule of Security House CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-08-B-008

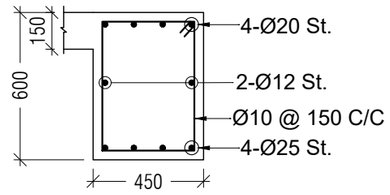
TENDER DRAWINGS



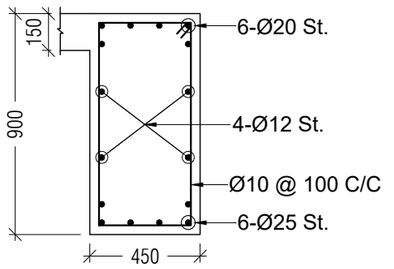
Security House
Grade Beam Layout Plan



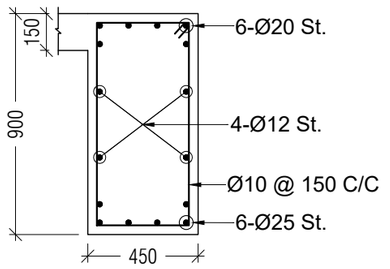
Section X1-X1



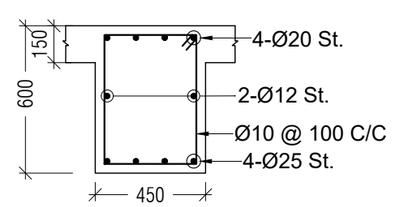
Section Y1-Y1



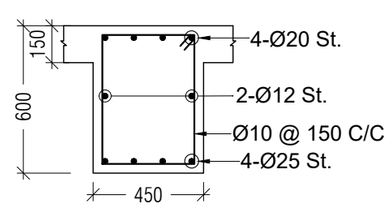
Section X2-X2



Section Y2-Y2



Section X3-X3



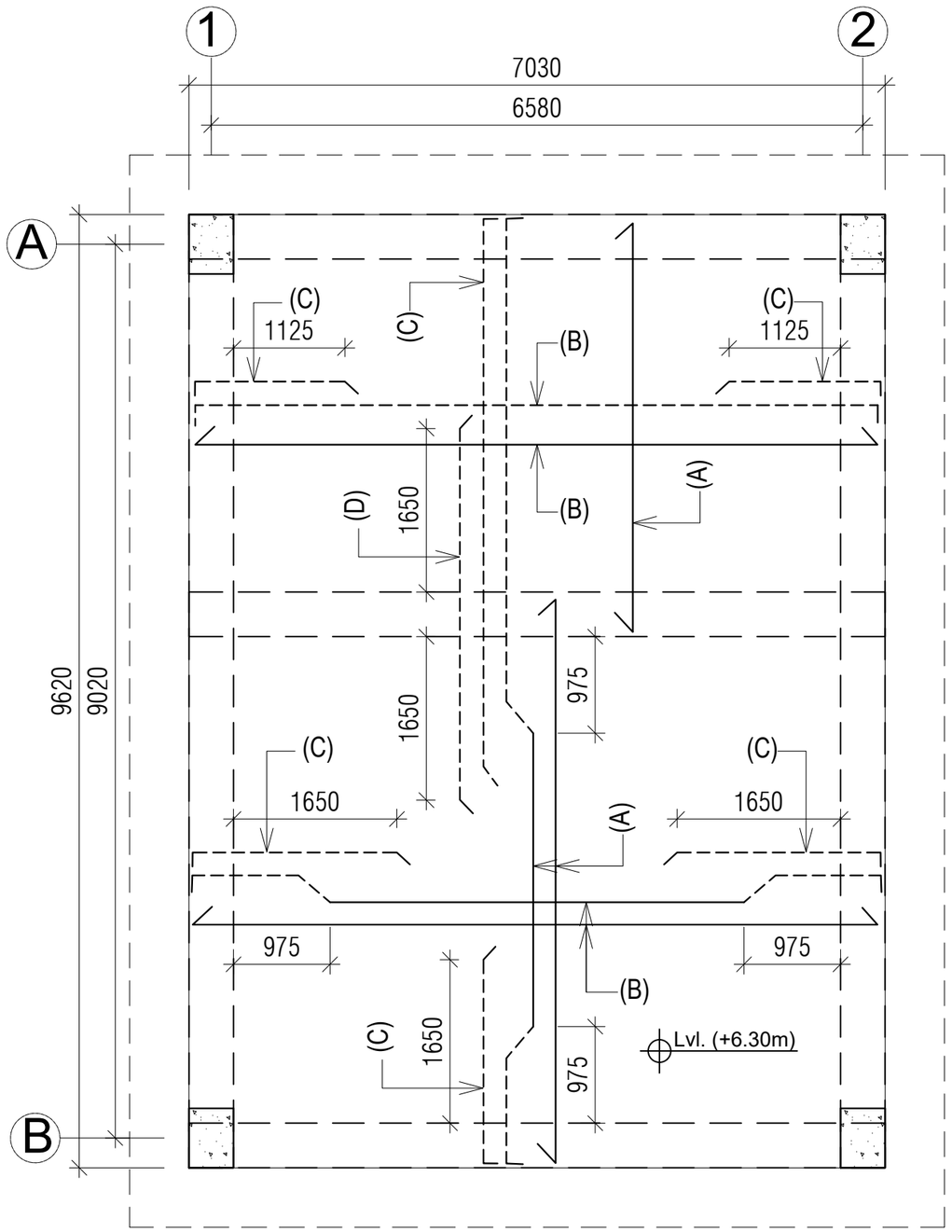
Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Ground Floor Column & Beam Layout Plan of Security House CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-B-009

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 200 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

N

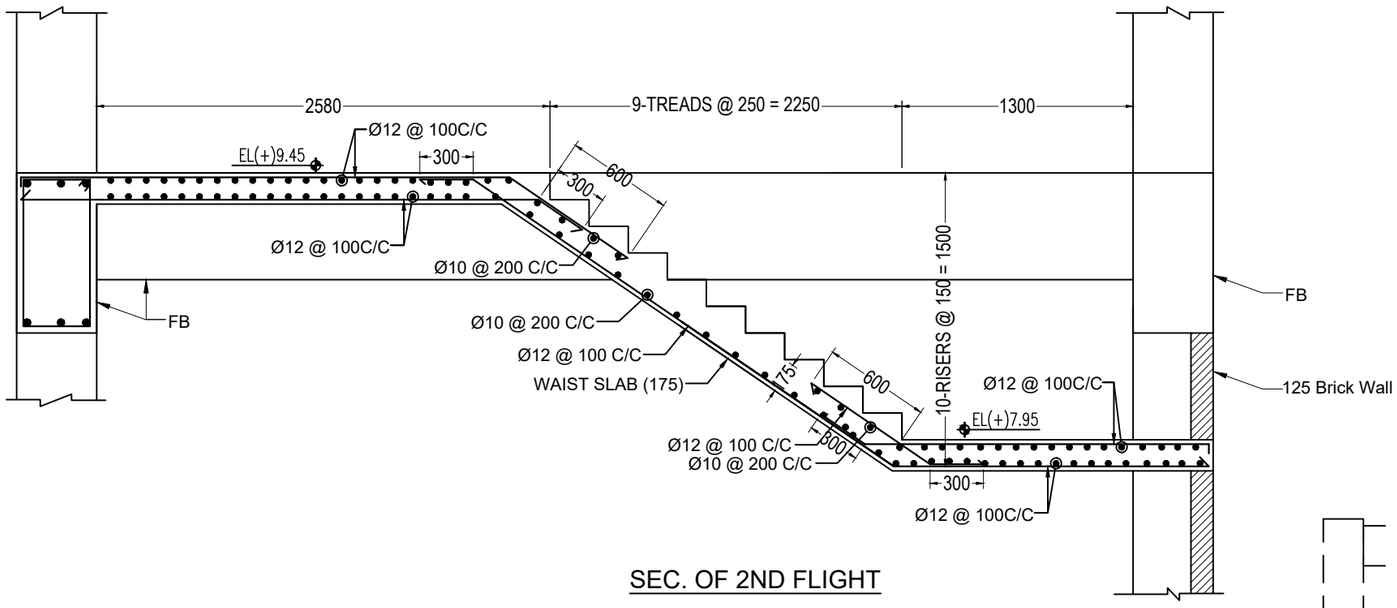
Security House
Ground Floor Slab Reinforcement Layout Plan

**All Levels are in Chart Datum

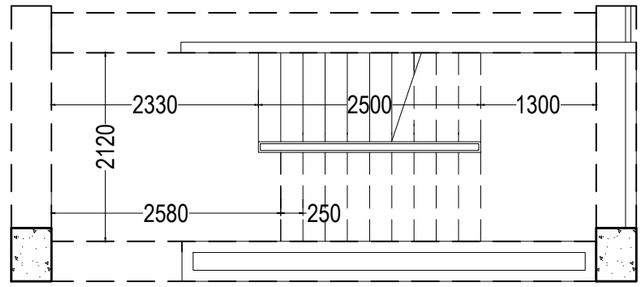
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Ground Floor Slab Reinforcement Layout Plan of Security House CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-B-010

Date: 30-Apr-2025
Status:
Revision: R-00

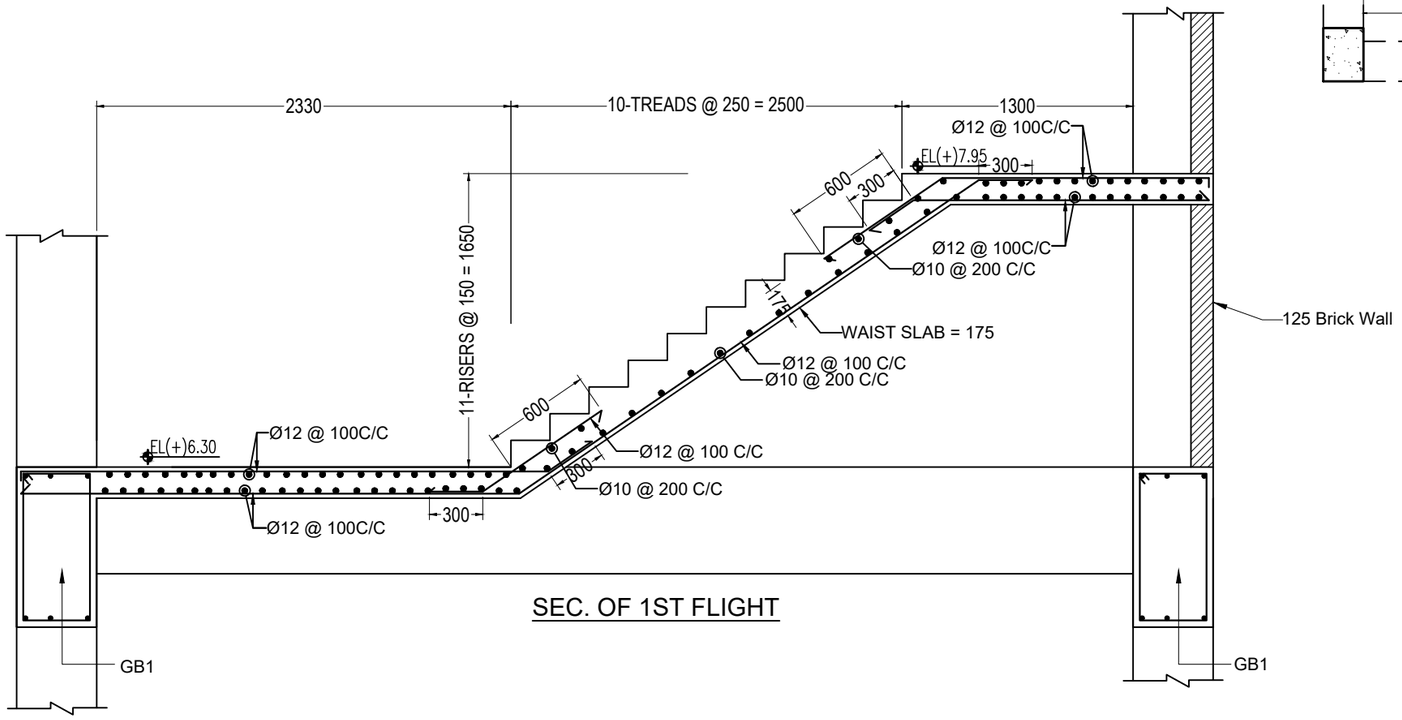
TENDER DRAWINGS



SEC. OF 2ND FLIGHT



STAIR LAYOUT PLAN AT LEVEL
+6.3m to +9.45m

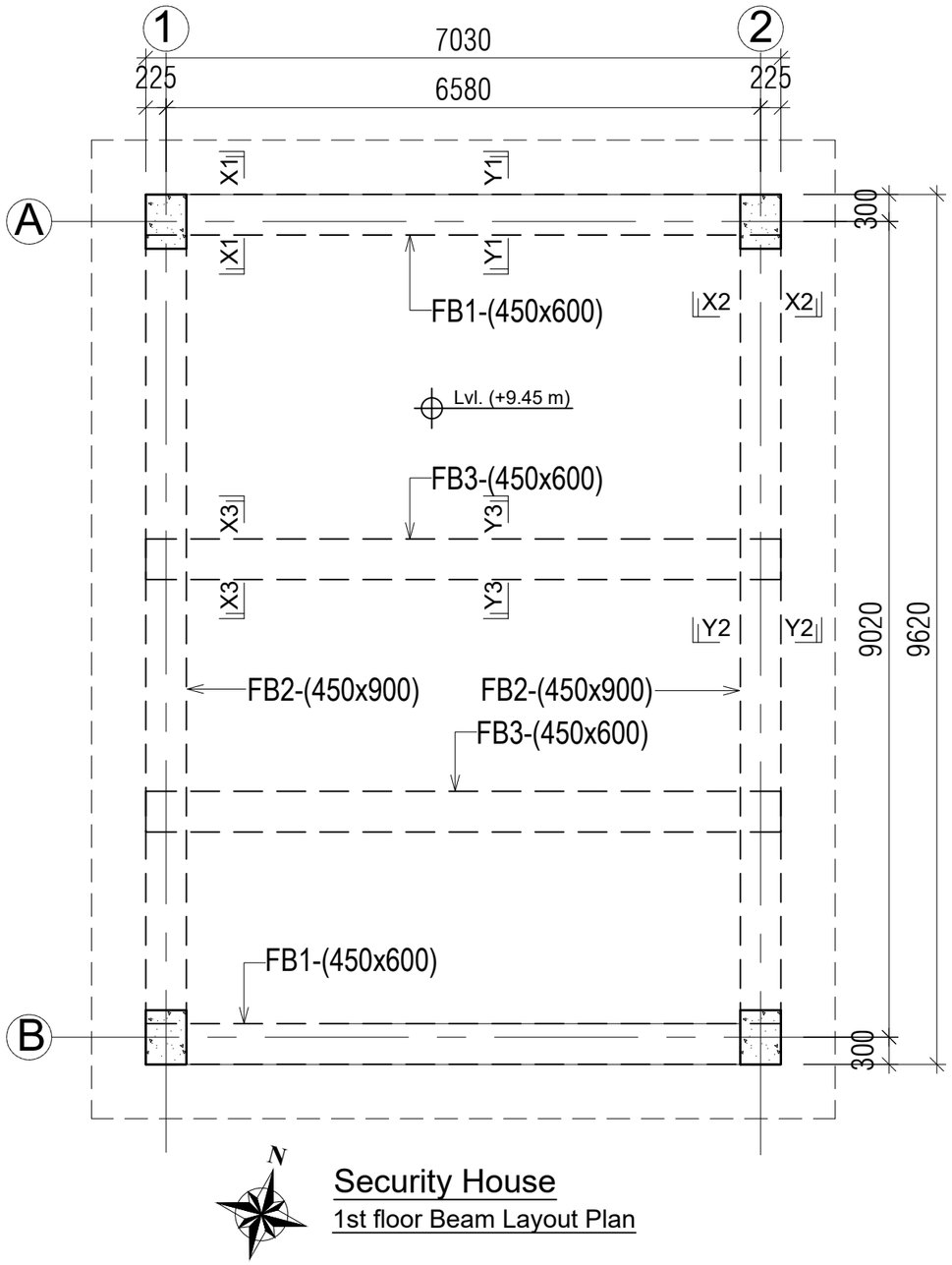


SEC. OF 1ST FLIGHT

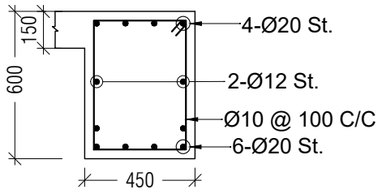
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System		Revision History:	
			SHEET TITLE: Stair Details of Security House		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-011	

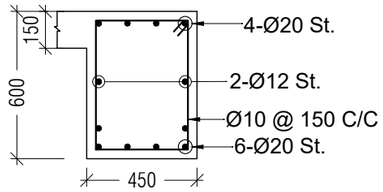
TENDER DRAWINGS



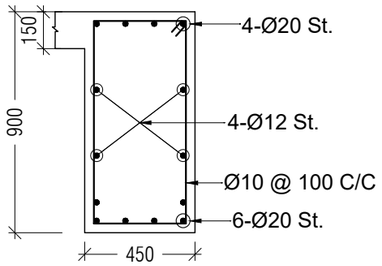
Security House
1st floor Beam Layout Plan



Section X1-X1



Section Y1-Y1



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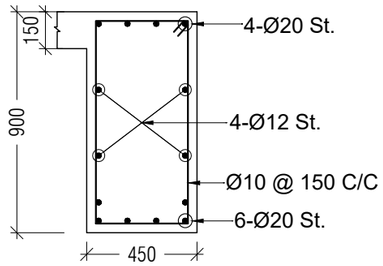
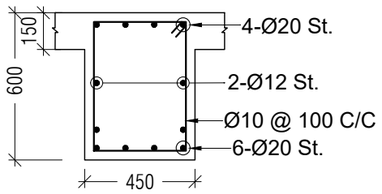
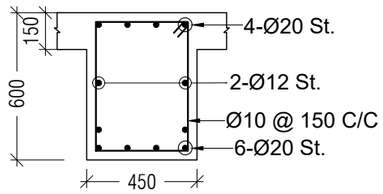


Section Y2-Y2



Section X3-X3

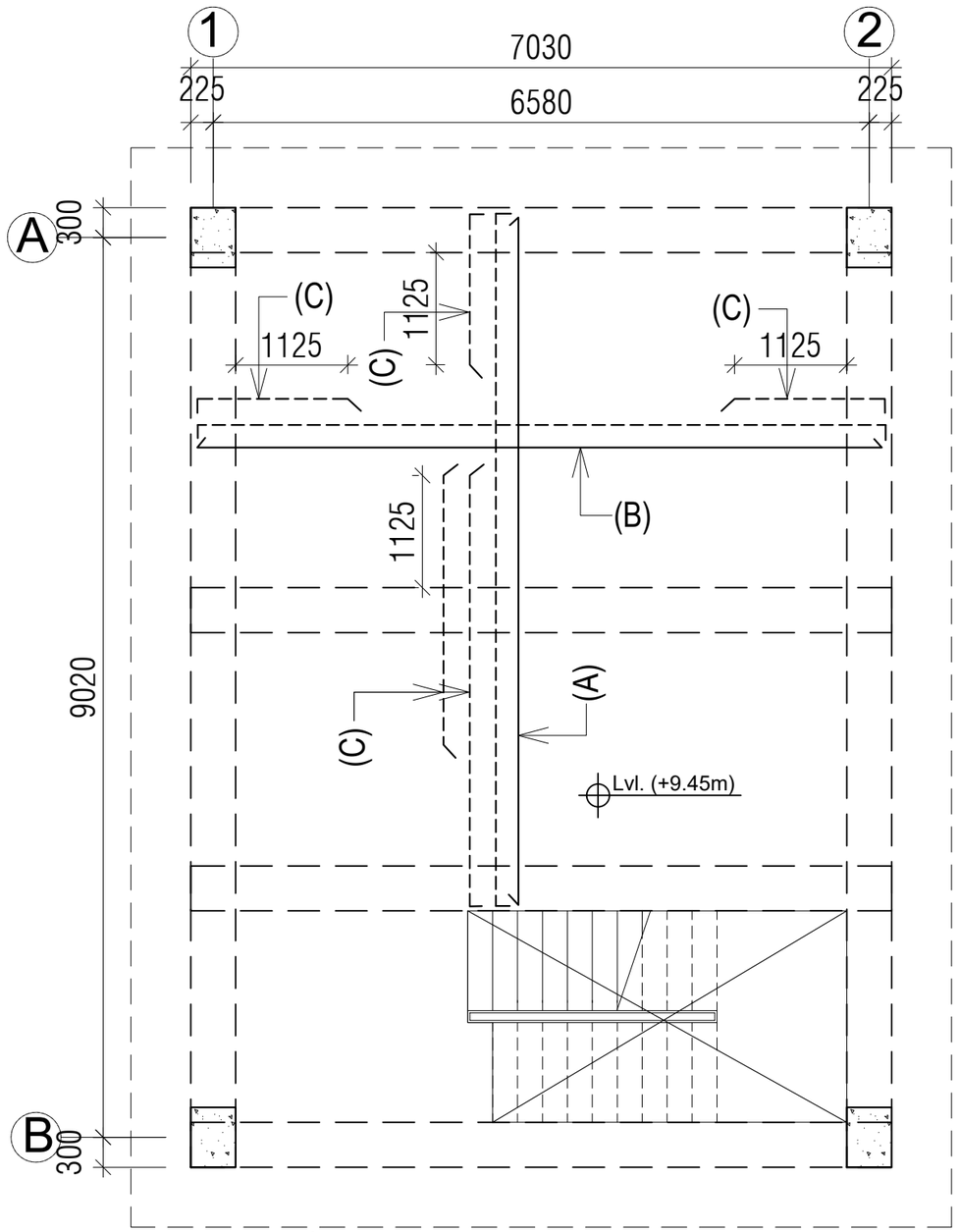


Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: 1st Floor Beam Layout Plan of Security House CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-B-012	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



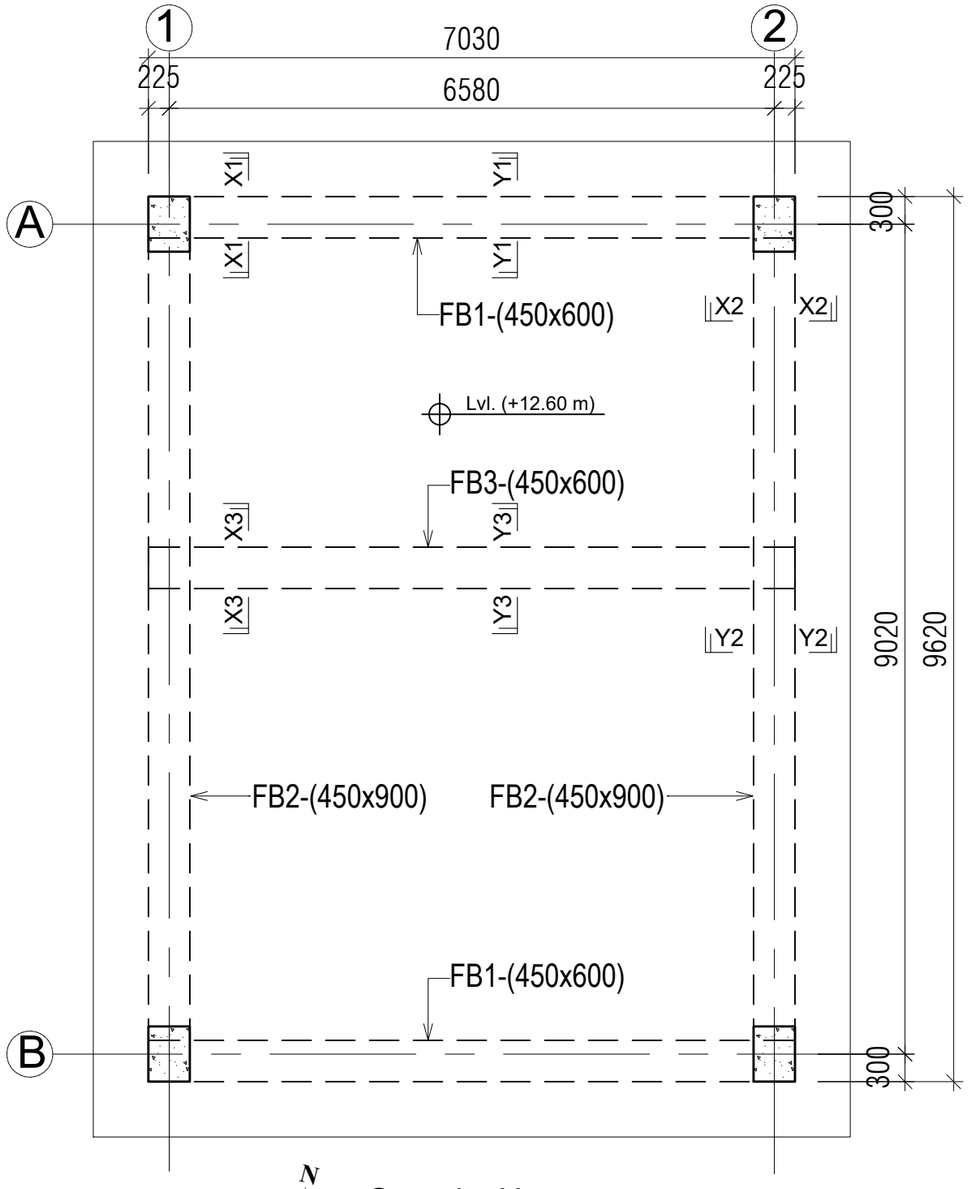
NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø10 @ 150 C/C ALT CKD.
   B = Ø10 @ 200 C/C ALT CKD.
   C = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

Security House
1st Floor Slab Reinforcement Layout Plan

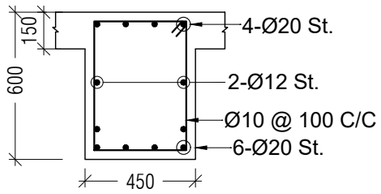
**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:
			SHEET TITLE: 1st Floor Slab Reinf. Layout Plan of Security House	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-08-B-013

TENDER DRAWINGS



Security House
Roof Beam Layout Plan



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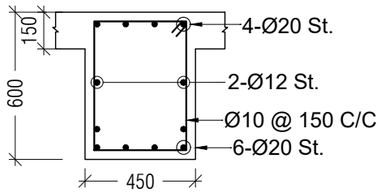

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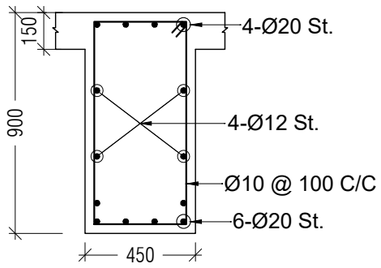

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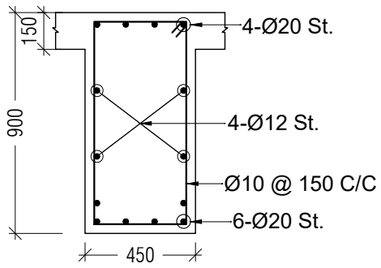
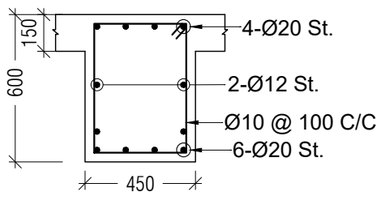
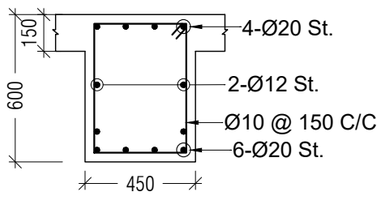


Section Y2-Y2



Section X3-X3

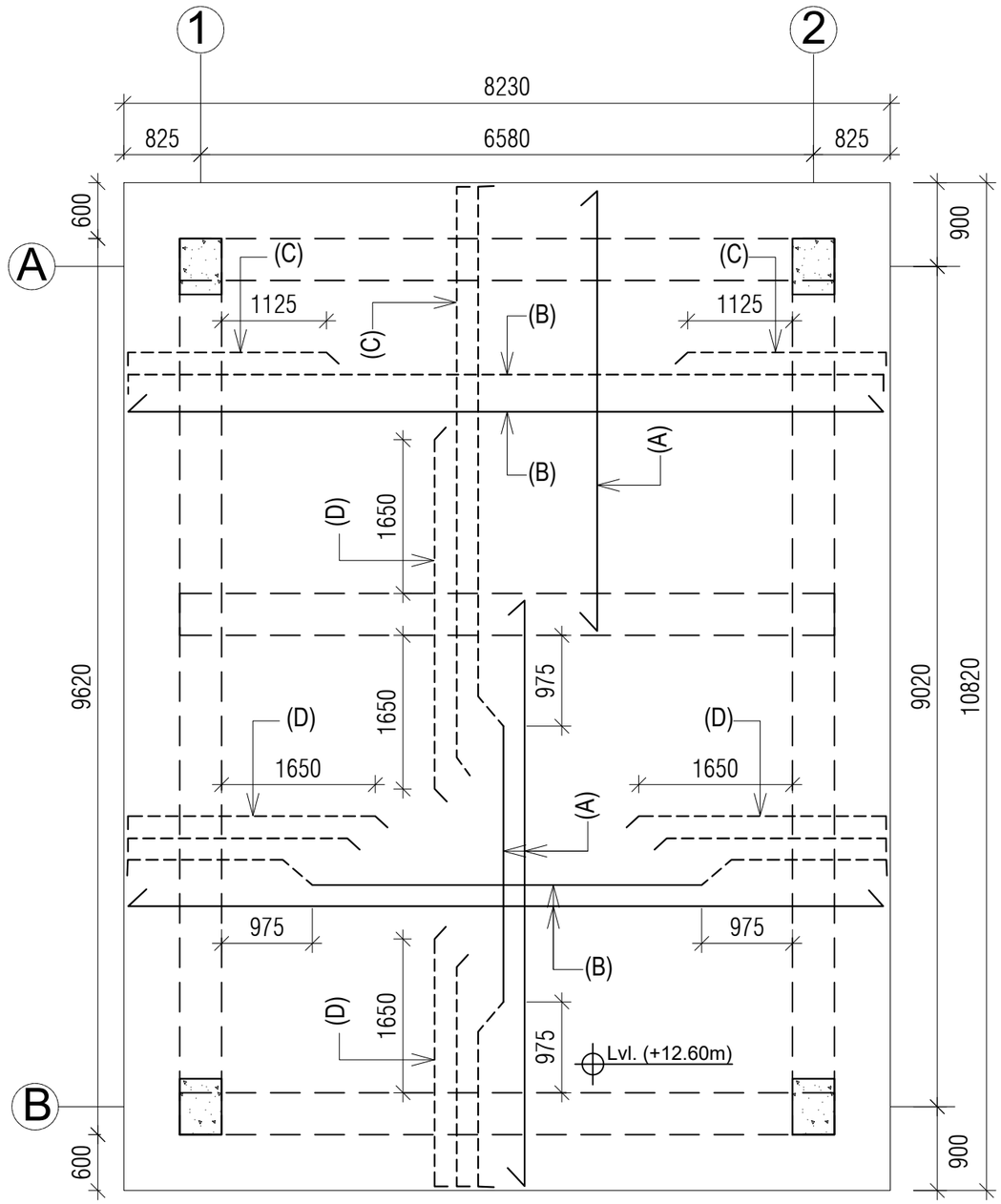


Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Roof Beam Layout Plan of Security House		1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-014

TENDER DRAWINGS



NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 200 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

**All Levels are in Chart Datum

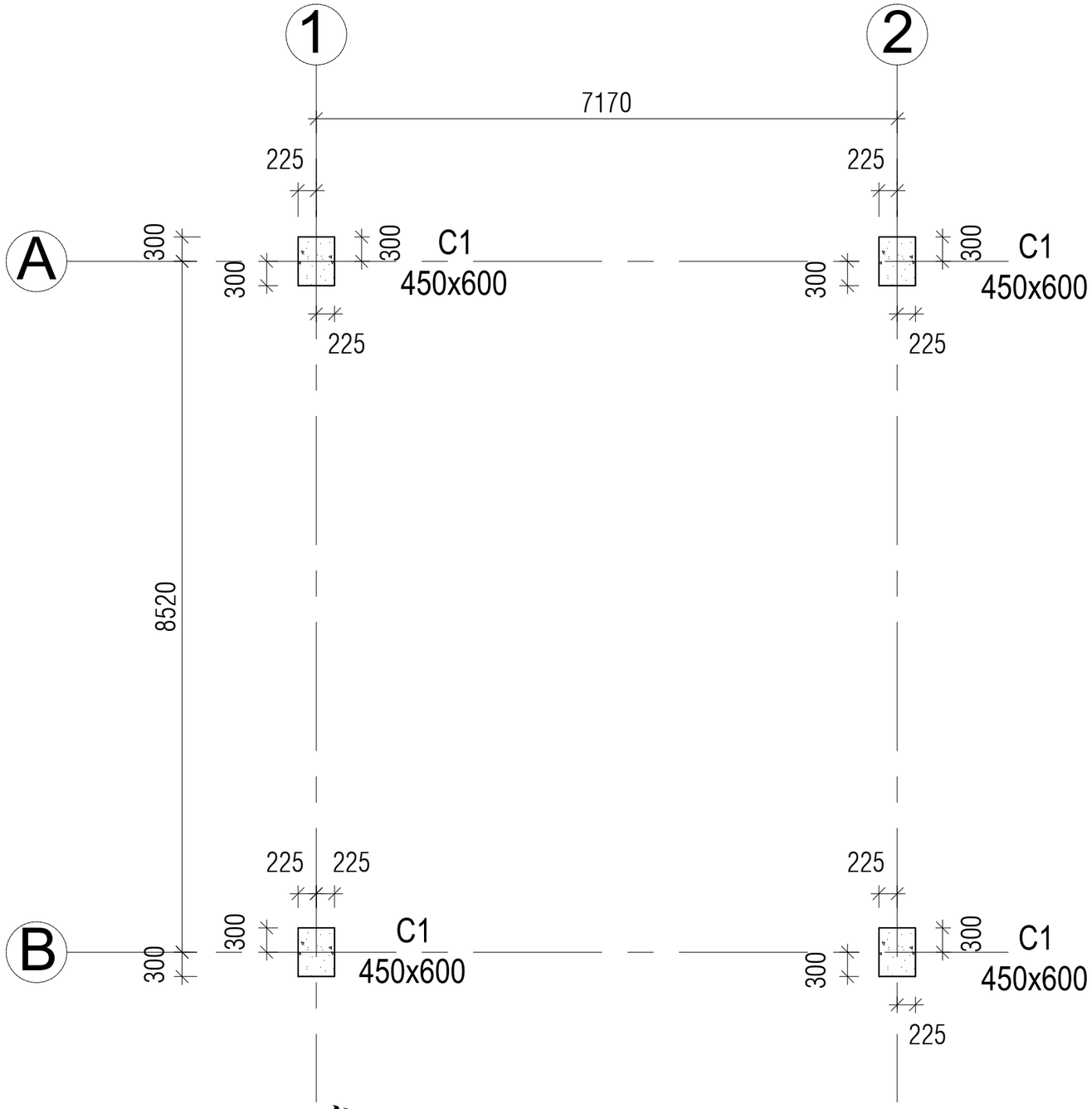
N

Security House

Roof Slab Reinforcement Layout Plan

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Roof Slab Reinforcement Layout Plan of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-015

TENDER DRAWINGS

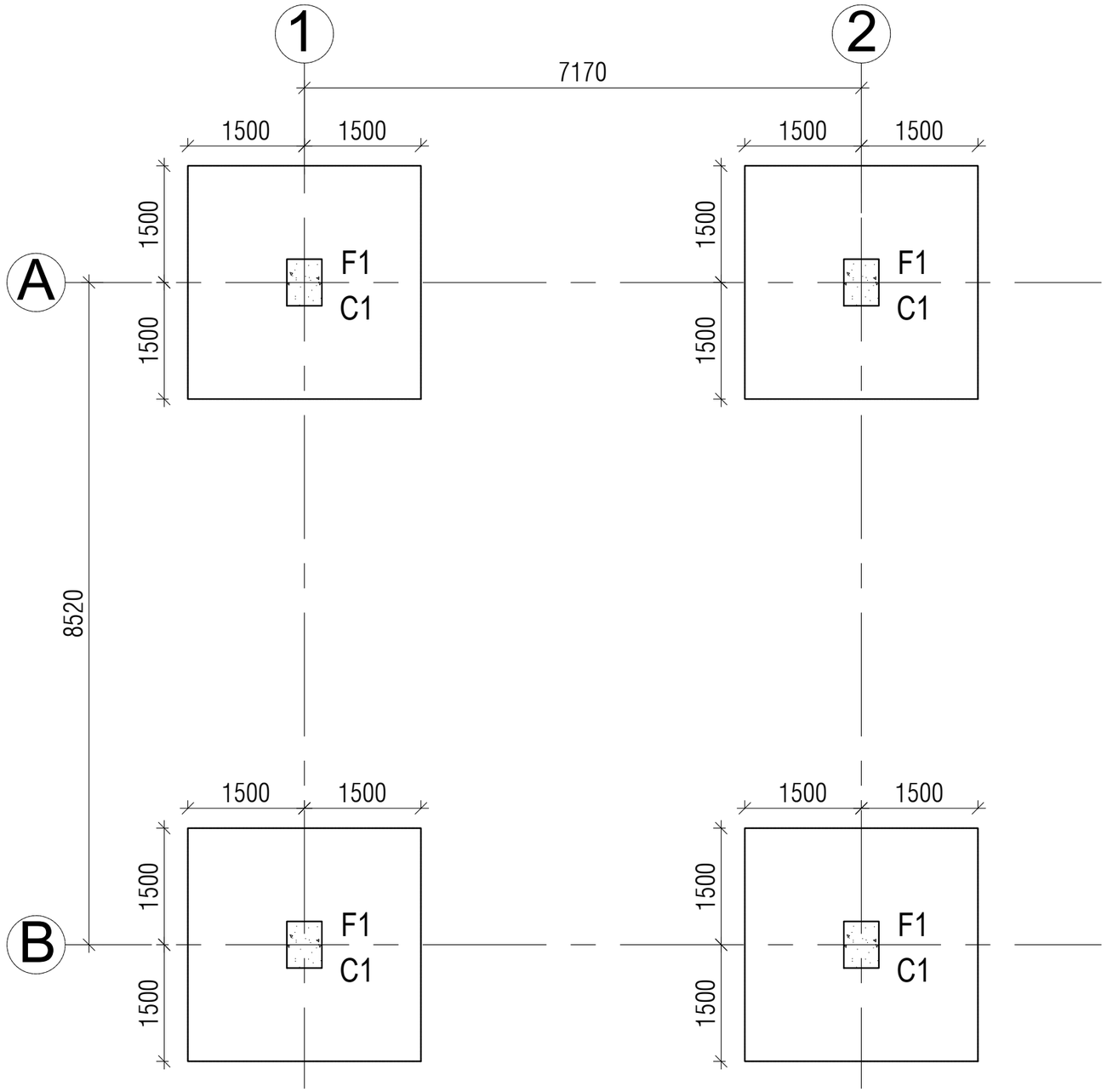


Column Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Column Layout Plan of Pump & Blasting System	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-B-016	

TENDER DRAWINGS



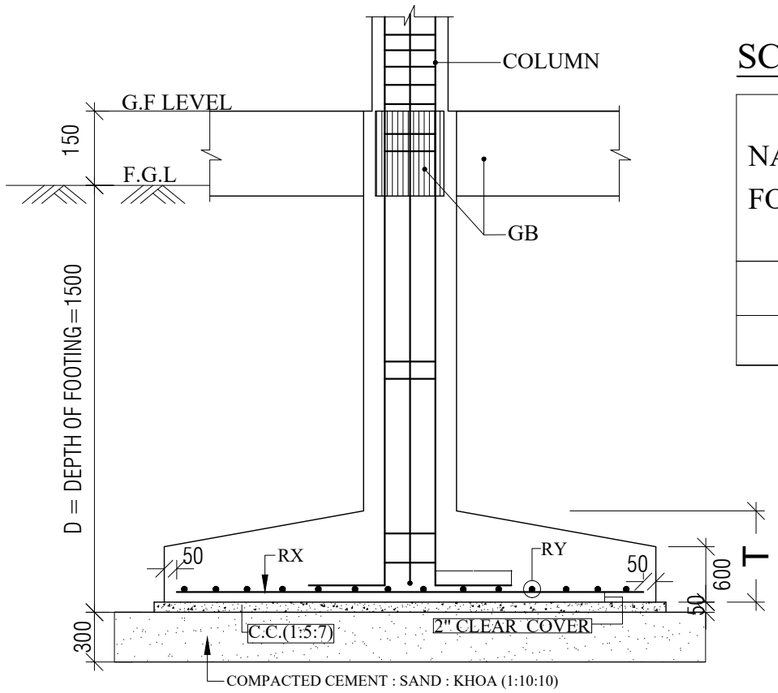
N

Footing Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Footing Layout Plan of Pump & Blasting System	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-B-017	

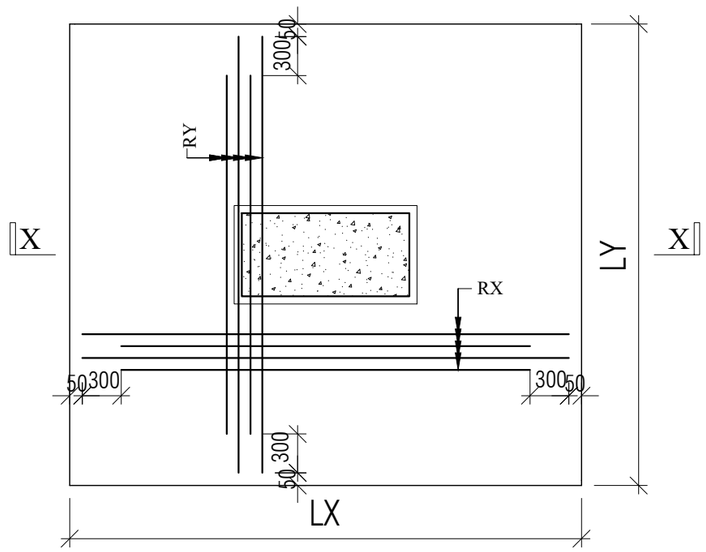
TENDER DRAWINGS



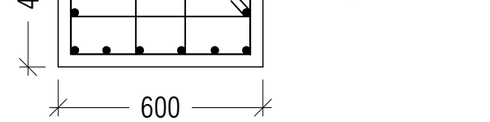
SECTION ON - X-X

SCHEDULE OF FOOTING :

NAME OF FOOTING	SIZE OF FOOTING		THICKNESS OF FOOTING	REINF. OF FOOTING.	
	LX	LY	T mm	Rx	Ry
F1	3000	3000	900	Ø16 @ 150 C/C	Ø16 @ 150 C/C



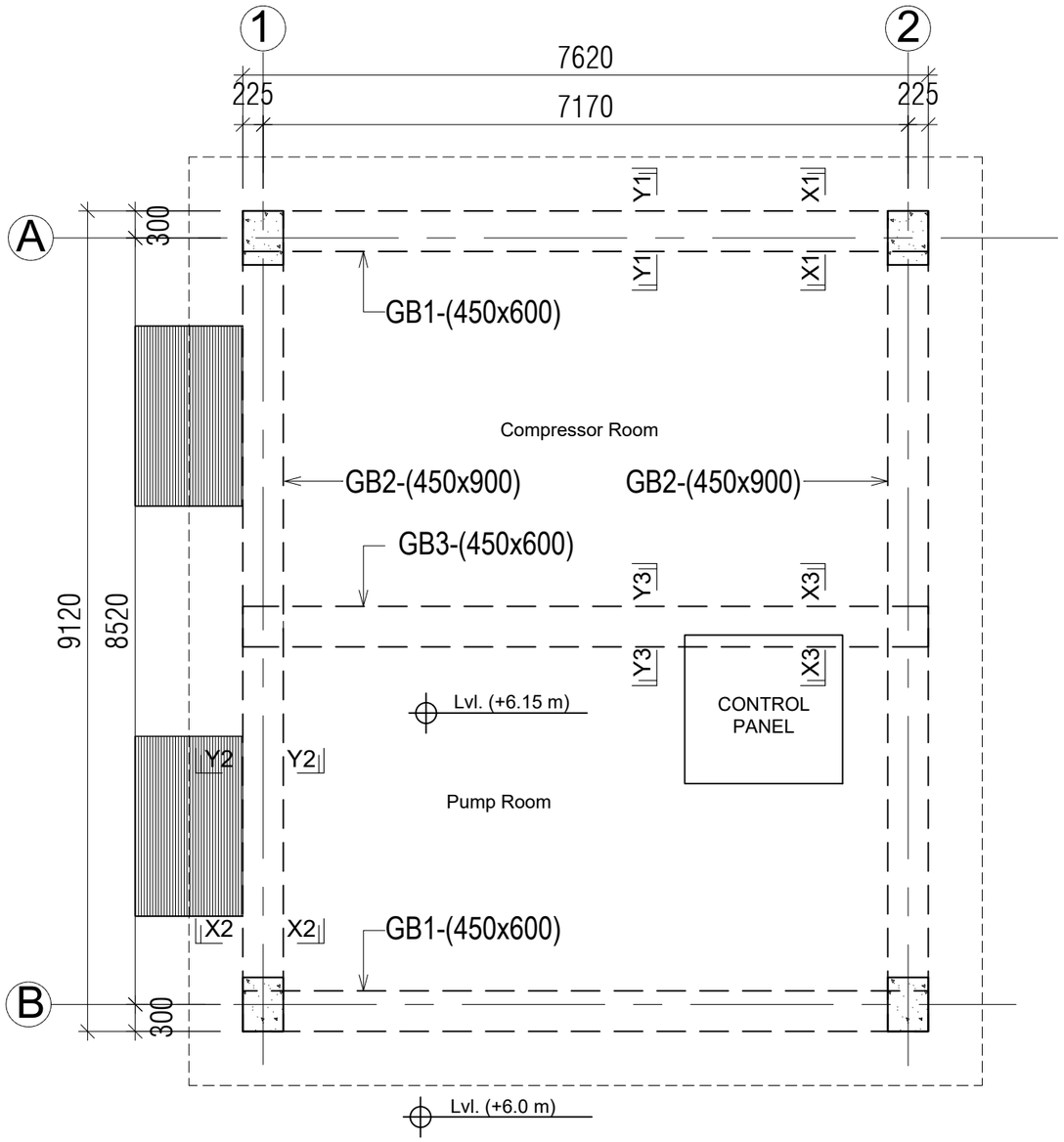
PLAN OF TYPICAL FOOTING



SEC OF COLUMN - C1

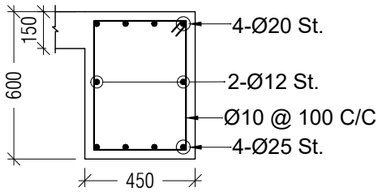
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Footing & Column Schedule of Pump & Blasting System CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-08-B-018

TENDER DRAWINGS

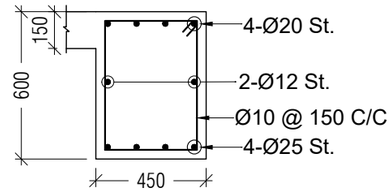


Pump & Blasting System

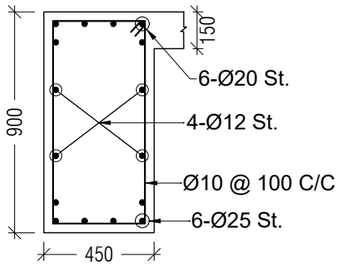
Grade Beam Layout Plan



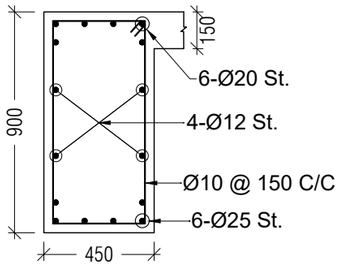
Section X1-X1



Section Y1-Y1



Section X2-X2



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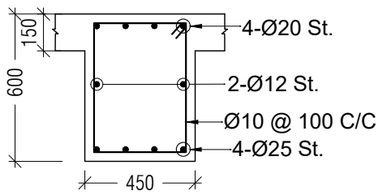
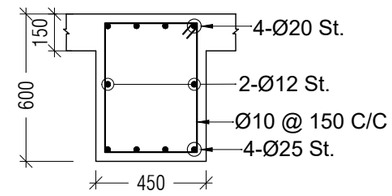


Section X3-X3

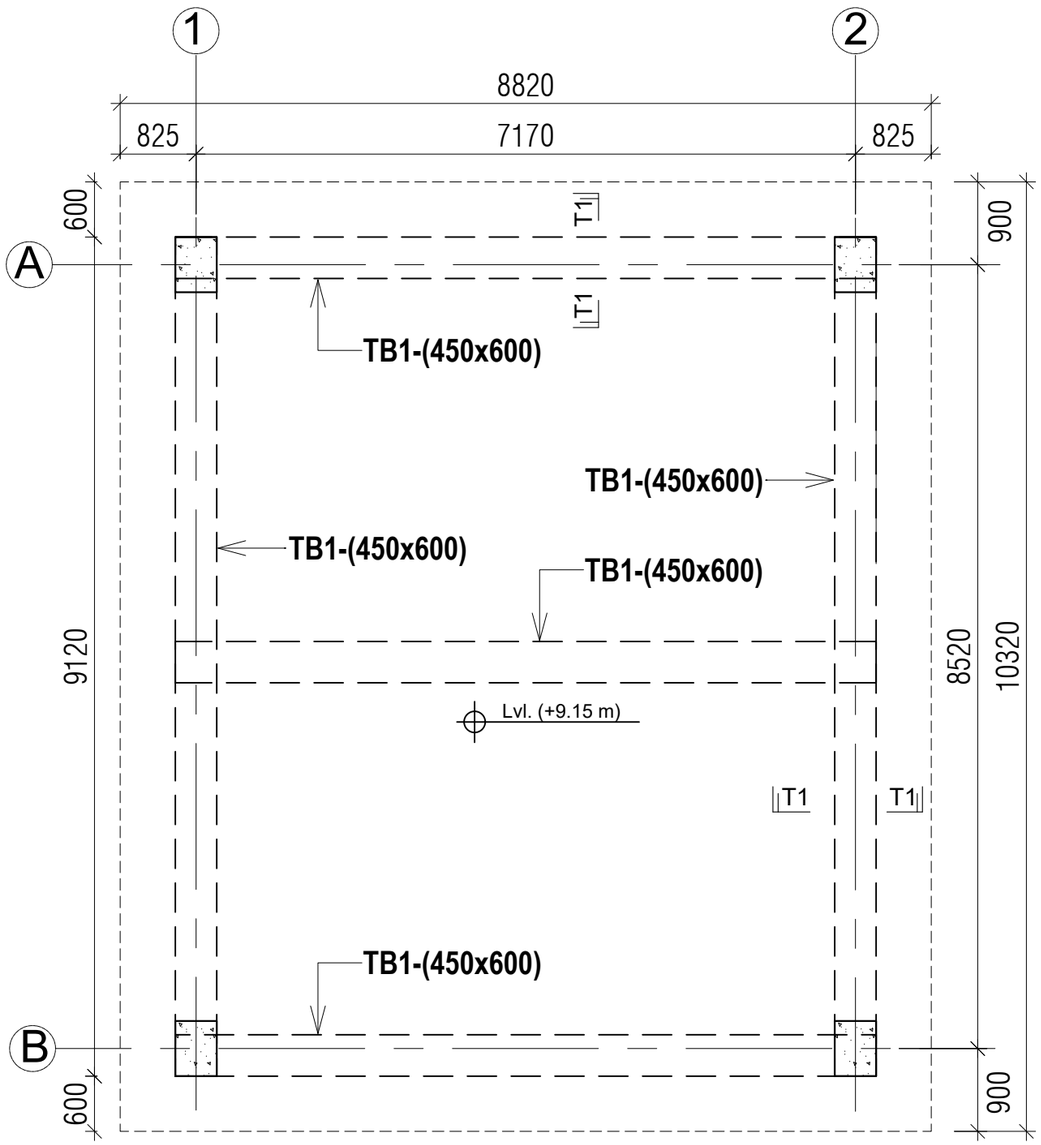


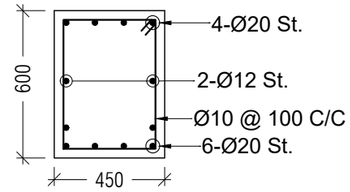
Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Ground Floor Column & Beam Layout Plan of Pump & Blasting System	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-019

TENDER DRAWINGS





SEC ON T1-T1

N

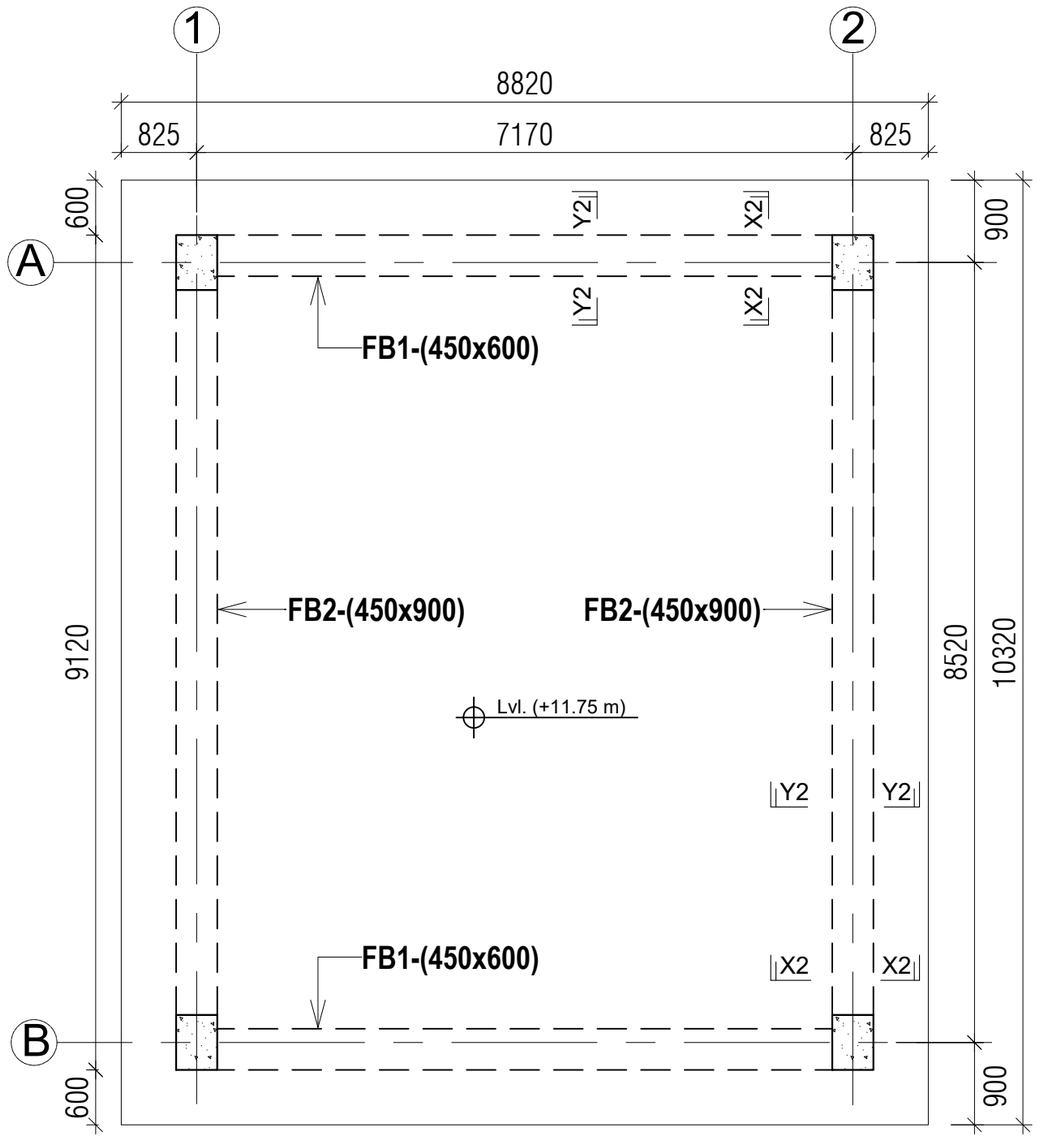
Pump & Blasting System

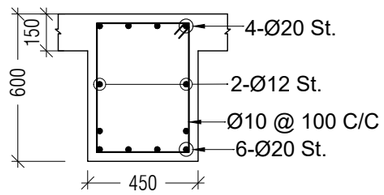
Tie Beam Layout Plan

**All Levels are in Chart Datum

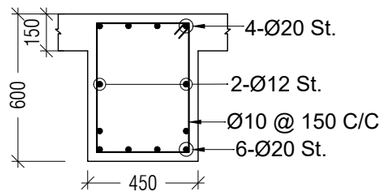
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Tie Beam Layout Plan of Pump & Blasting System		1. Date: 30-Apr-2025
					2. Status:
					3. Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-B-020

TENDER DRAWINGS

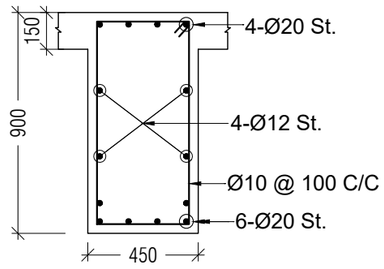




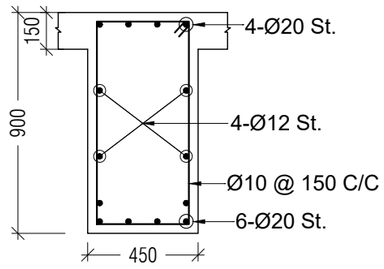
SEC ON X1-X1



SEC ON Y1-Y1



SEC ON X2-X2



SEC ON Y2-Y2

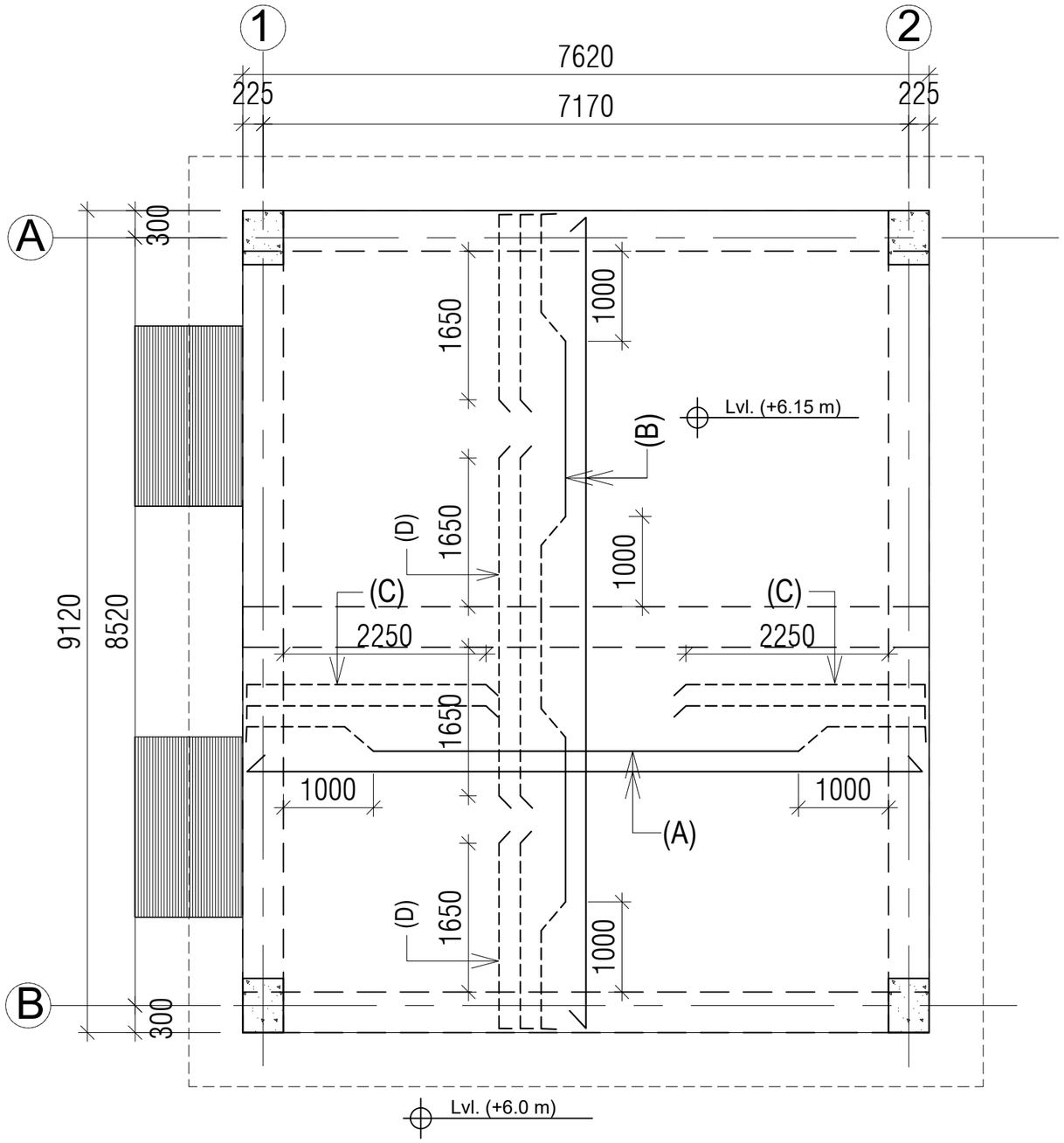
N

Pump & Blasting System
Floor Beam Layout Plan

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System	Revision History:
			SHEET TITLE: Floor Beam Layout Plan of Pump & Blasting System	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Drg No. D-08-B-021

TENDER DRAWINGS



NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 200 C/C ALT CKD.
   C = 2-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

**All Levels are in Chart Datum

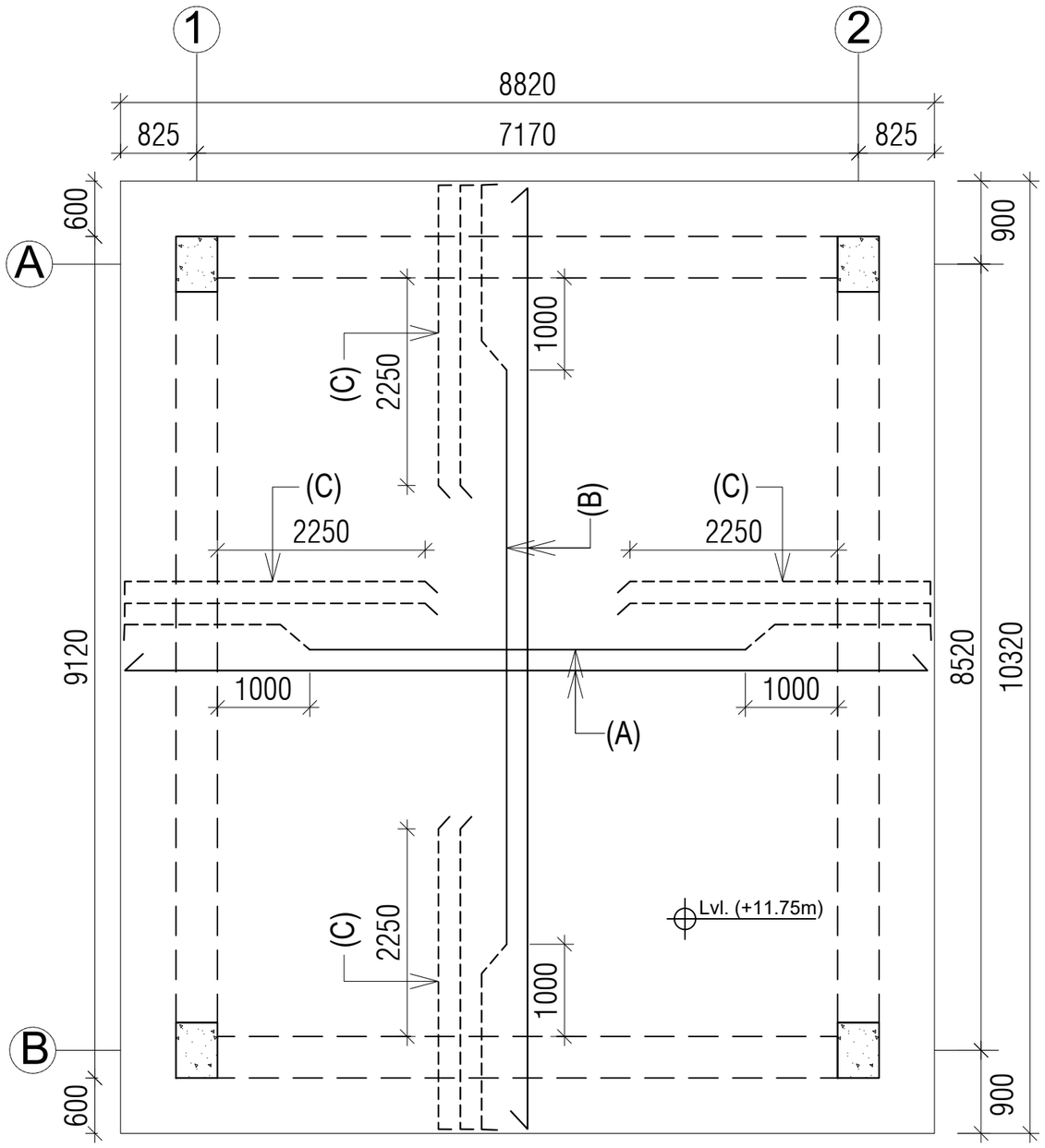
N

Pump & Blasting System

Grade Floor Slab Reinforcement Layout Plan

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Ground Floor Slab Reinforcement Layout Plan of Pump & Blasting System CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-08-B-022

TENDER DRAWINGS



NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 150 C/C ALT CKD.
   B = Ø12 @ 200 C/C ALT CKD.
   C = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

**All Levels are in Chart Datum

N

Pump & Blasting System

Slab Rainforcement Layout Plan

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Security House, Pump & Blasting System SHEET TITLE: Slab Reinforcement Layout Plan of Pump & Blasting System CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN
			Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-08-B-023

TENDER DRAWINGS

ELECTRICAL LEGEND

Suffix	Symbol	Description	Mounting Height (Bottom)
MDB		Main Distribution Board	750mm Top from F.F.L
SDB		Sub Distribution Board	2250mm Top from F.F.L
SB		Electric Switch Board With 2-pin, 5A Socket ESB= Emergency switch board, Generator	1200mm Top from F.F.L
TL		1200mm-36 watt, LED Tube light	2250mm Top from F.F.L
F		Ceiling Fan, 1220 or 1422mm	Mounted at Ceiling from Hook
CL		Ceiling LED Light, 12 watt	Ceiling/ False Ceiling
EXF		300mm Exhaust Fan, 45 watt	2400mm Top from F.F.L
BL		Bracket LED light, 23/15/10 watt	2250mm Top from F.F.L
DP		3-Pin, 13A Flat Type Combined Switch Socket	200 or 750mm Top from F.F.L
M		5-Pin, 5/13A Multi Type Combined Switch Socket	200 or 750mm Top from F.F.L
TRL		Track Light , 12 watt LED, outside of building	1500mm Top from F.F.L

INSTRUCTIONS:

*All conduits for point wiring should be 25mm pvc pipe unless specified otherwise.

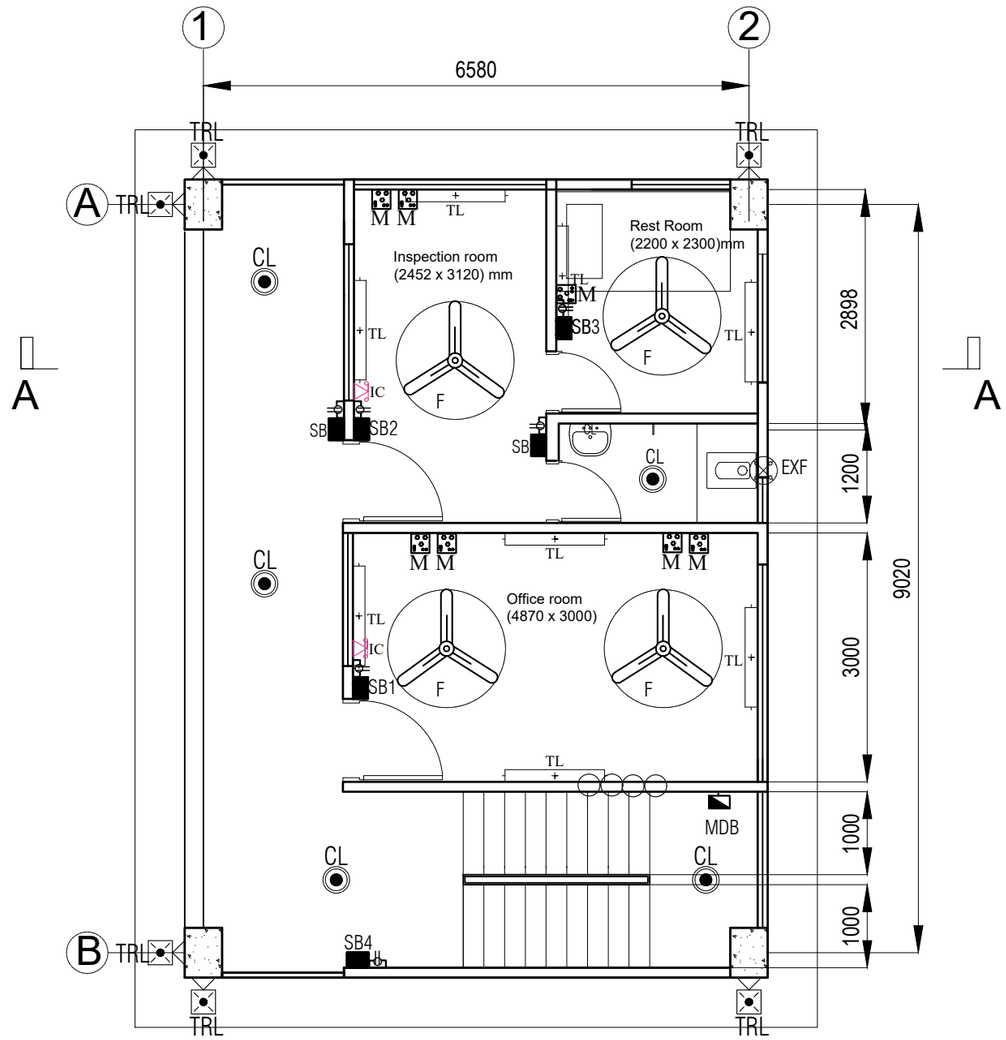
*All conduits for main electric cable from LT panel and CDB (Common Distribution Board) should be minimum 50mm pvc pipe or higher if required according to cable size.

*Use separate conduit pvc pipe for electrical fixture & power sockets and telecommunication points

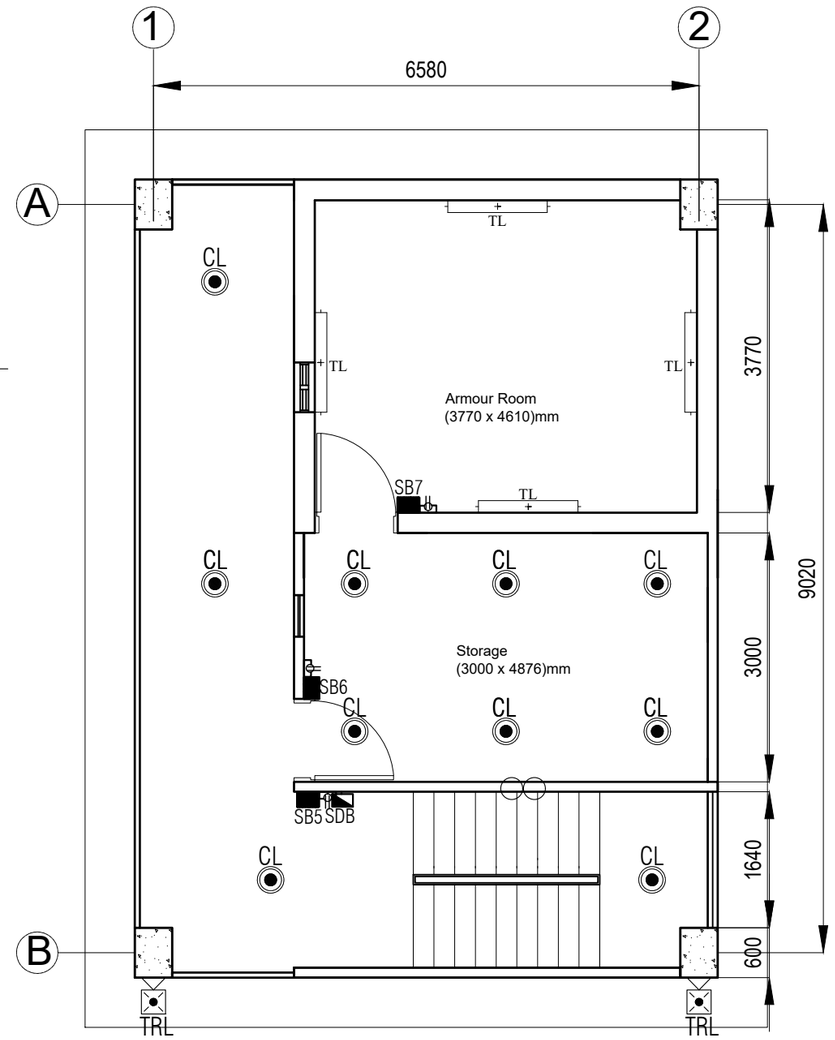
*Use the cable schedule as defined in the Single Line Diagram of relevant drawing for electrical & telecom point wiring.
*1c-2x1.5 sq. mm BYA for light & fan point
*1c-2x2.5sq. mm BYA+1c-2.5 sq. mm BYA (green) for circuit & power point.
*1c-2x4.0 sq. mm BYA+1c-4.0 sq. mm BYA (green) for 1-ϕ a/c point
*1c-4x4.0 sq. mm BYA+1c-4.0 sq. mm BYA (green) for 3-ϕ, 4ton/ 5ton a/c point

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Electrical Legend	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision:
			SCALE: AS SHOWN	Drg No. D-08-C-001	

TENDER DRAWINGS



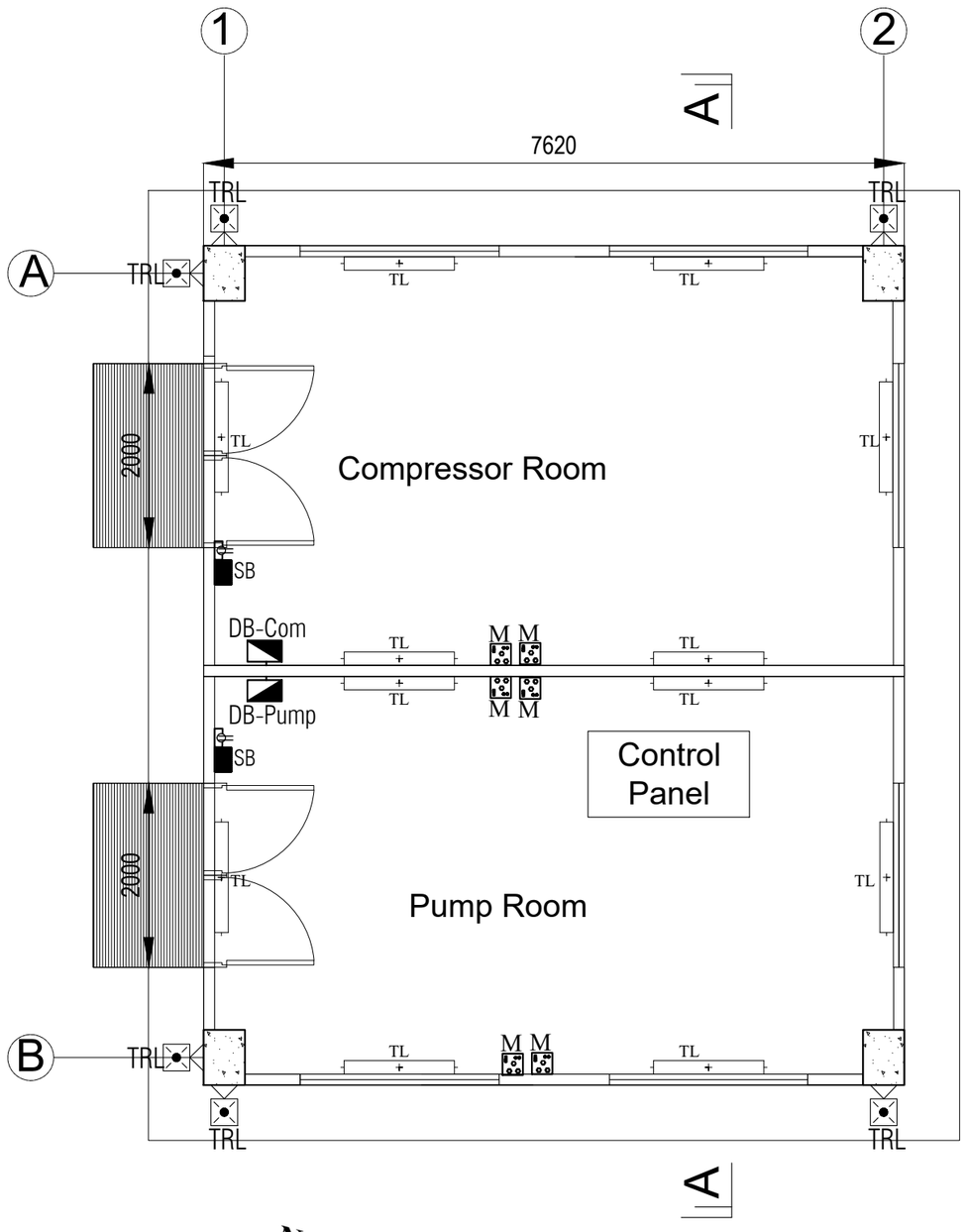
Ground Floor Plan
Security House



First Floor Plan
Security House

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.
DRG. TITLE: Electrical Design of Security House, Pump & Blasting System	Revision History:	
SHEET TITLE: Electrical Fixture Layout of Security System	1.	Date: 30-Apr-2025
	2.	Status:
	3.	Revision:
SCALE: AS SHOWN	Drg No. D-08-C-002	

TENDER DRAWINGS

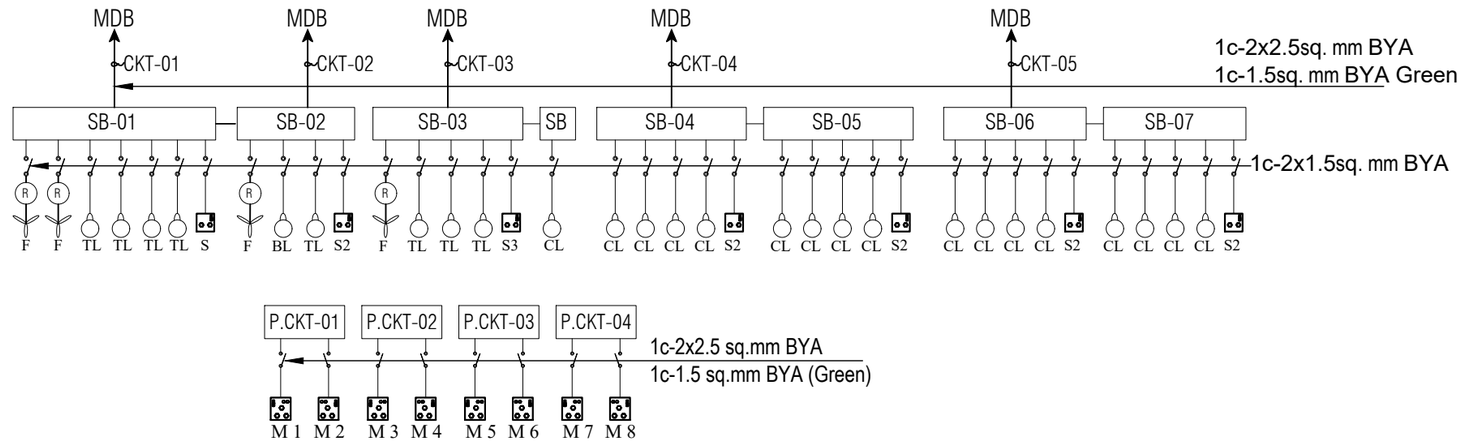


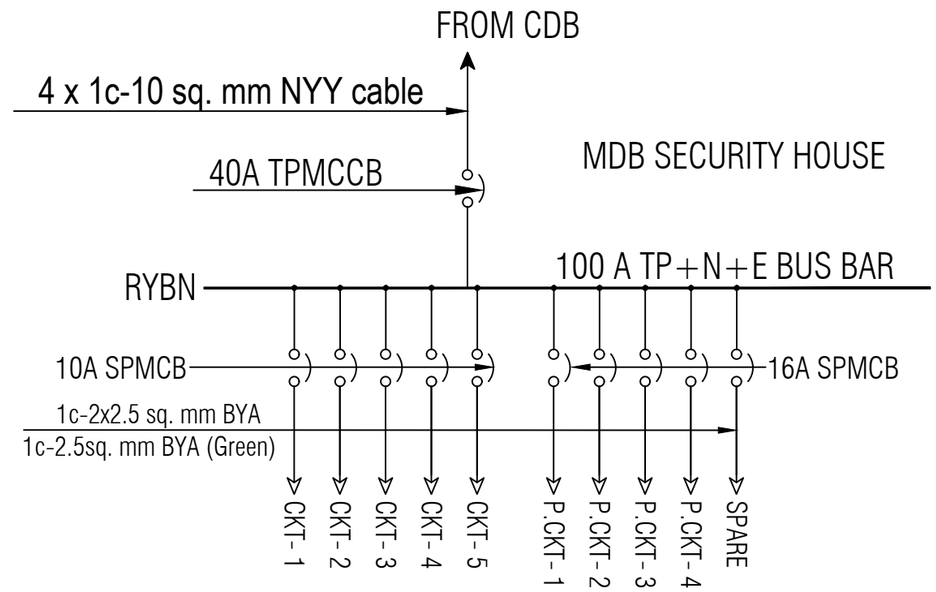
N

GROUND FLOOR PLAN
Pump & Blasting System

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Electrical Fixture Layout of Pump and Blasting System	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision:
			SCALE: AS SHOWN	Drg No. D-08-C-003	

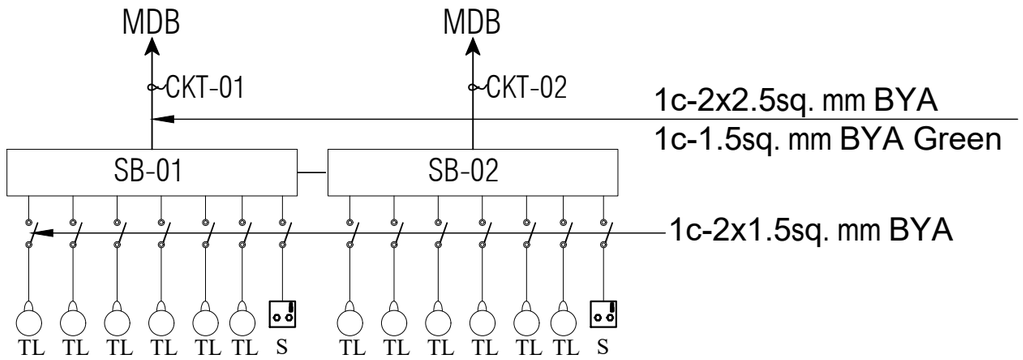
TENDER DRAWINGS

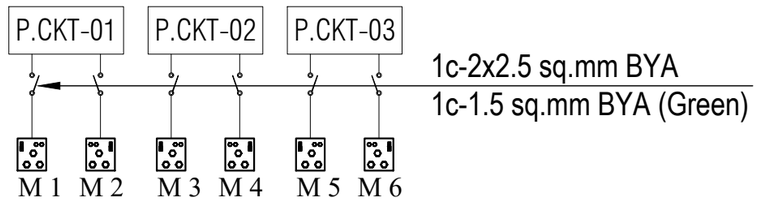


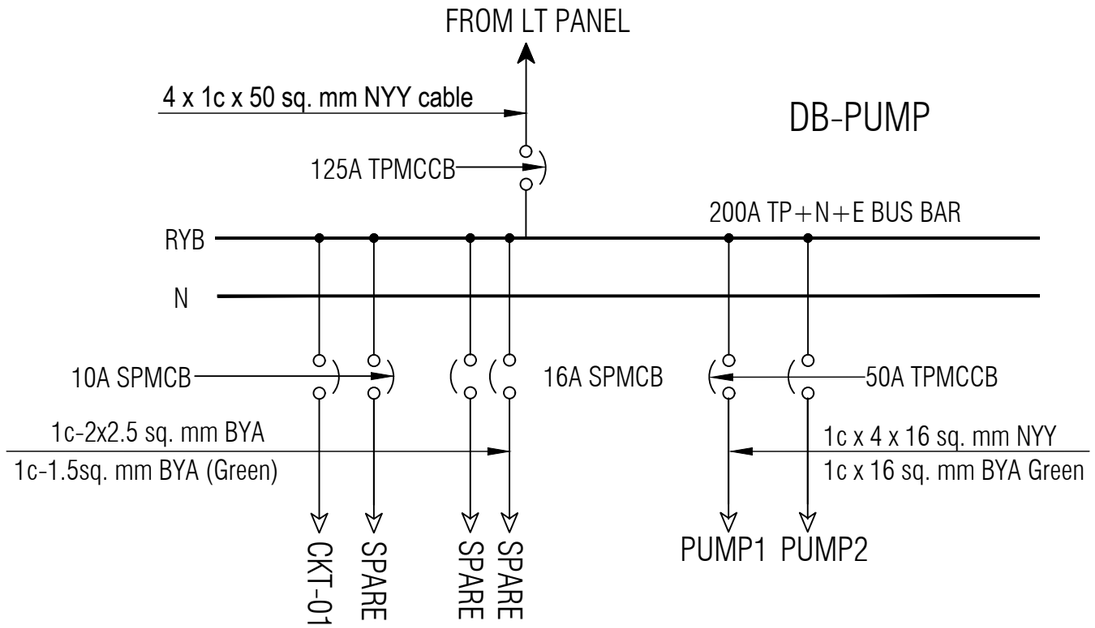


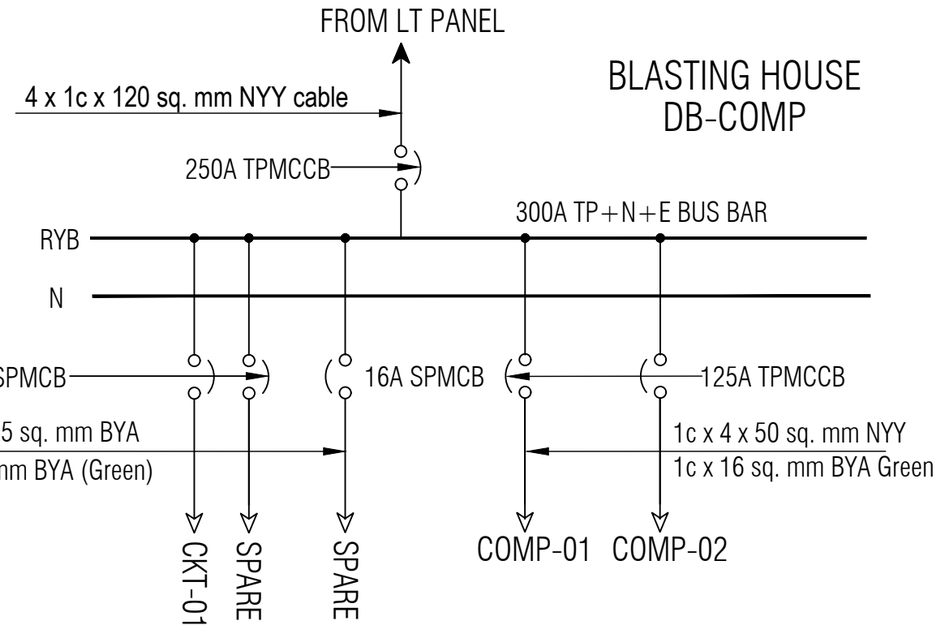
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Security House, Pump & Blasting System SHEET TITLE: Single Line Diagram of Main Distribution Board Security House SCALE: AS SHOWN	Revision History: 1. 2. 3.	 Date: 30-Apr-2025 Status: Revision: Drg No. D-08-C-004

TENDER DRAWINGS



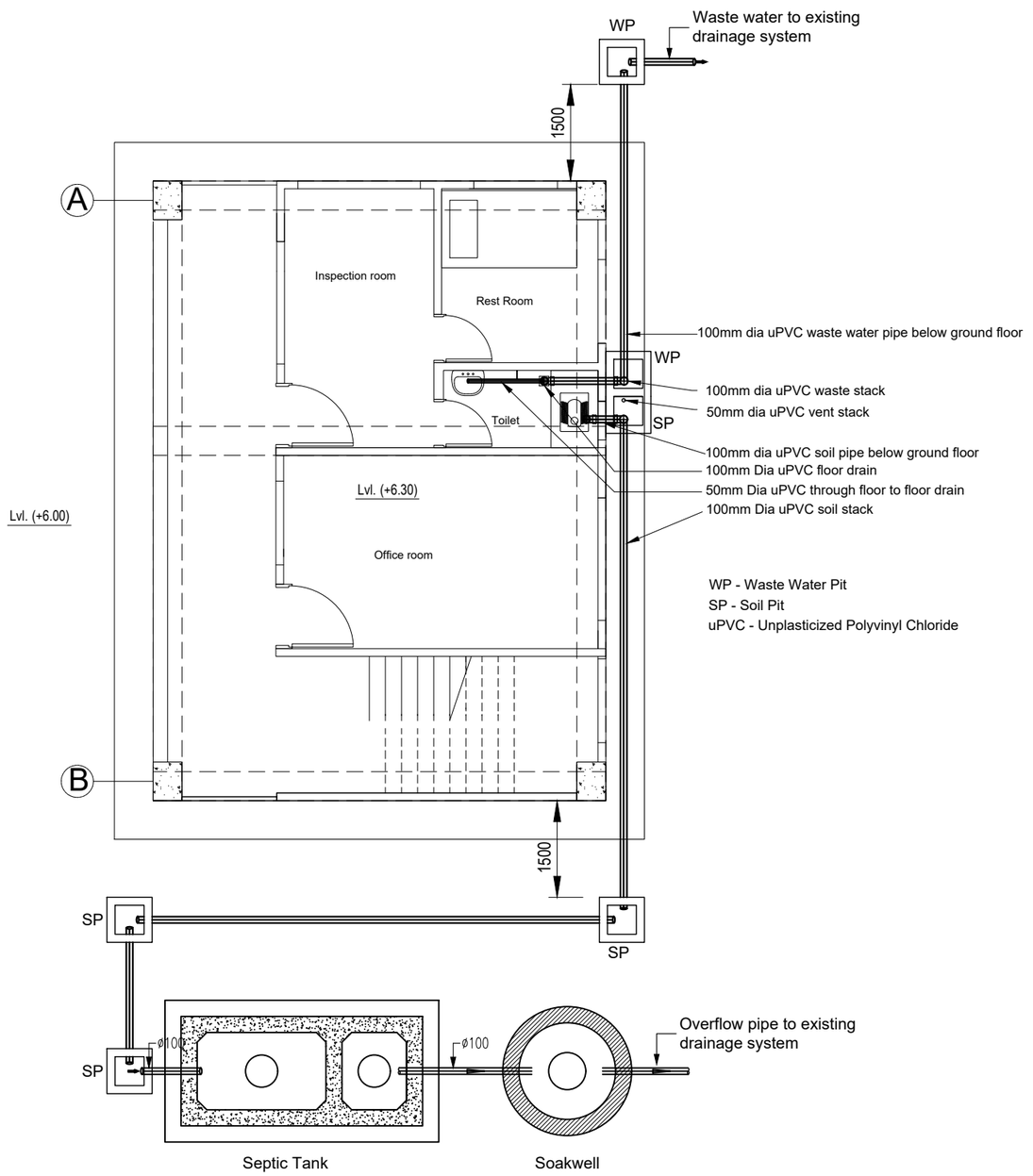






PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Design of Security House, Pump & Blasting System SHEET TITLE: Single Line Diagram of Main Distribution Board Pump and Blasting House SCALE: AS SHOWN	Revision History: 1. Rev. 01, Dt. 13-04-2025 2. 3.	Date: 30-Apr-2025 Status: Revision: Drg No. D-08-C-005

TENDER DRAWINGS



N

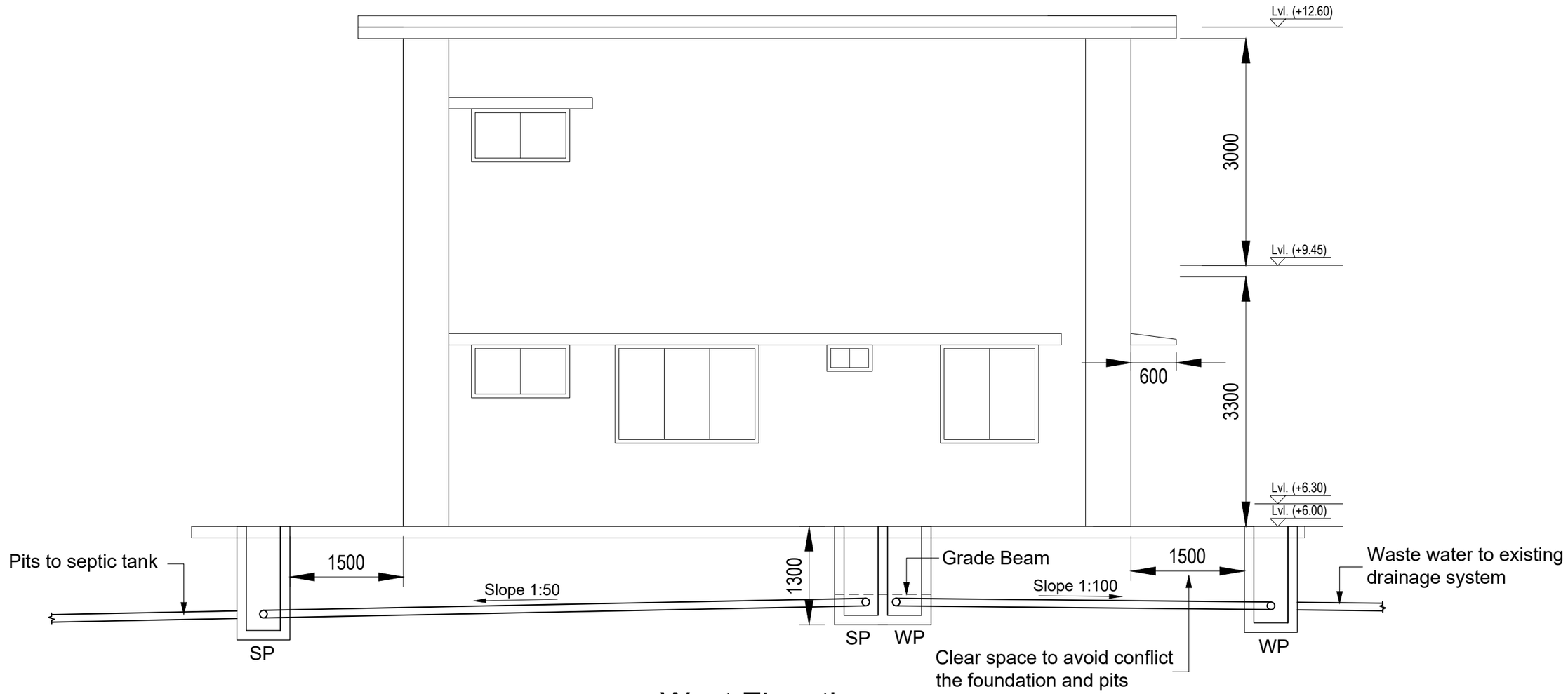
Security House

Ground floor sanitary piping layout

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Ground Floor Sanitary Piping Layout of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-001	

TENDER DRAWINGS



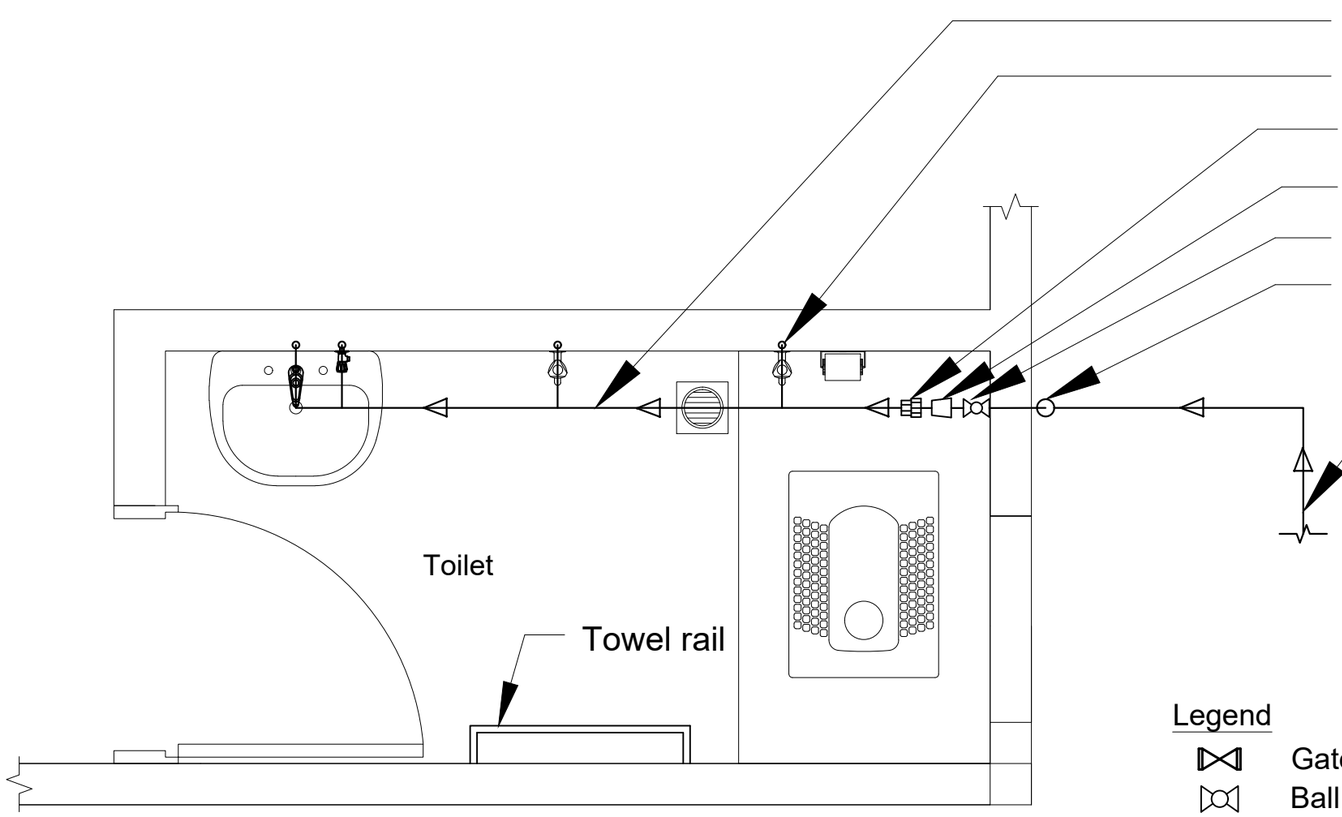
West Elevation

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System SHEET TITLE: Sanitary Piping Layout at West Elevation of Security House CAD BY: MD. ABDUL HALIM — SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-08-D-002

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



Security House
Ground floor water supply layout

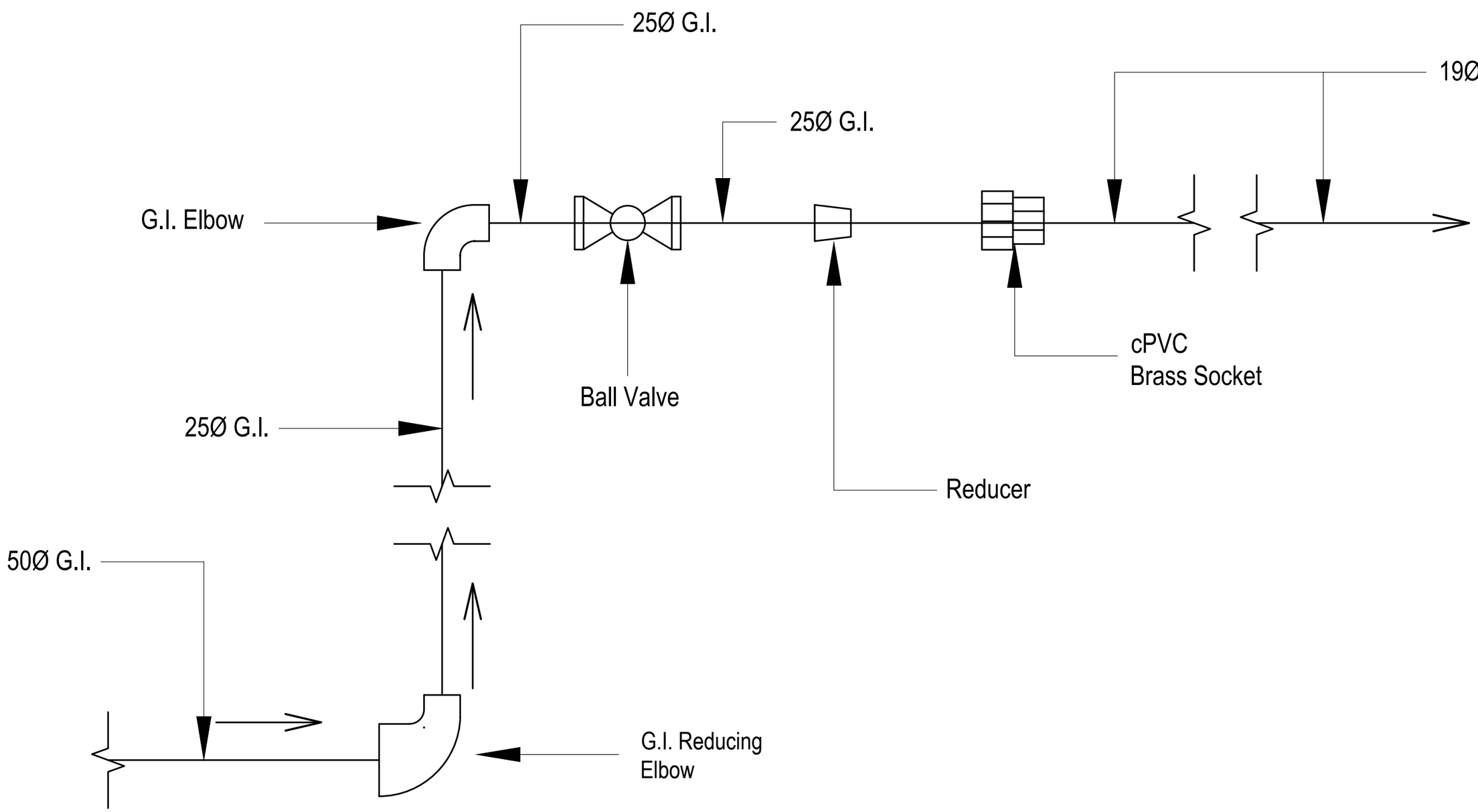
Legend

- Gate Valve
- Ball Valve
- Reducer
- cPVC Brass Socket
- Towel Rail
- Bib Cock
- Pillar Cock
- Floor Trap
- Tissue Holder
- Angular Stop Cock

**All Levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:
			SHEET TITLE: Ground Floor Water supply Layout of Security House	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-003

TENDER DRAWINGS

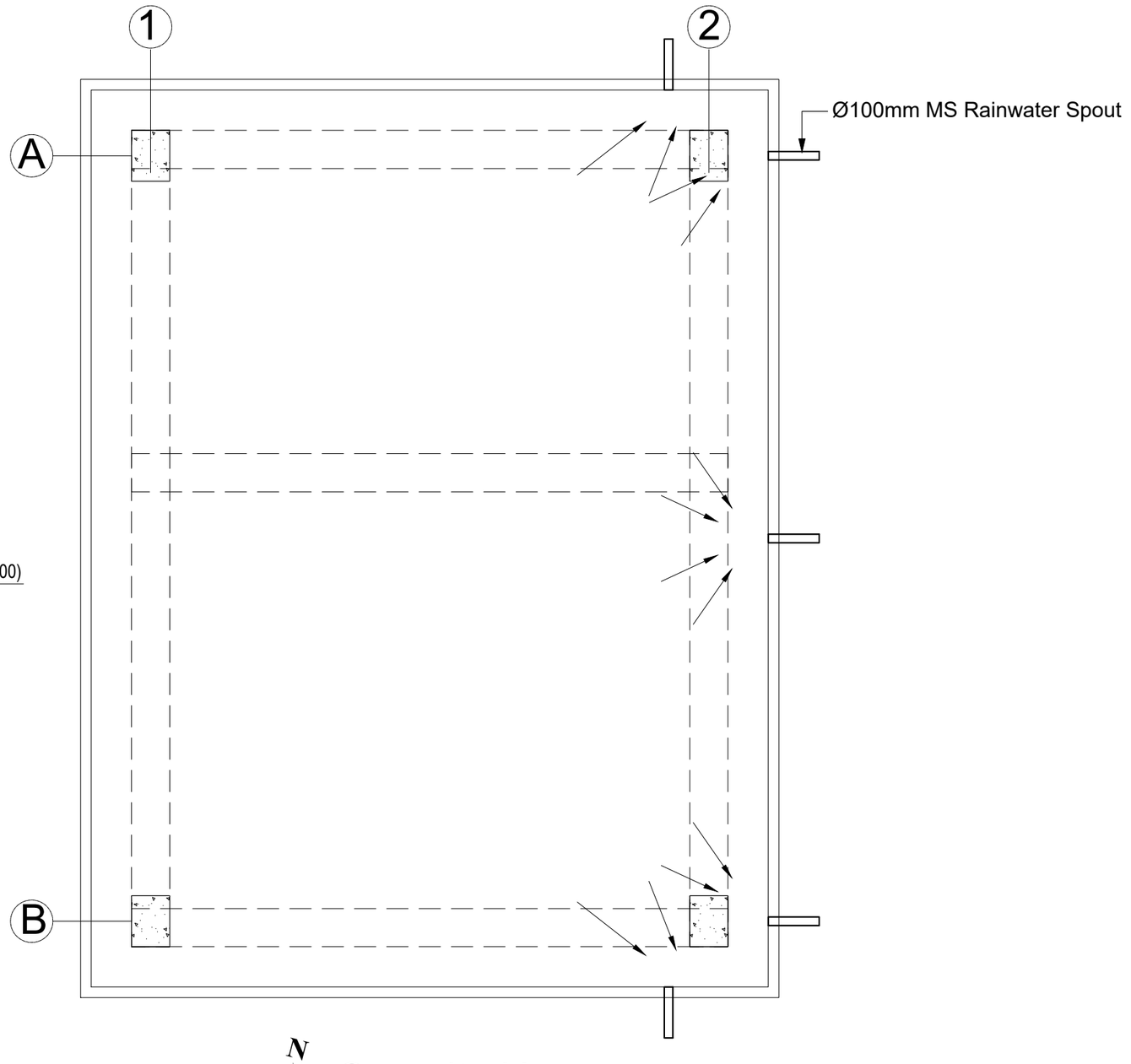


Water Supply Connection Details

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Water Supply Connection Details	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-004	

TENDER DRAWINGS



Security House

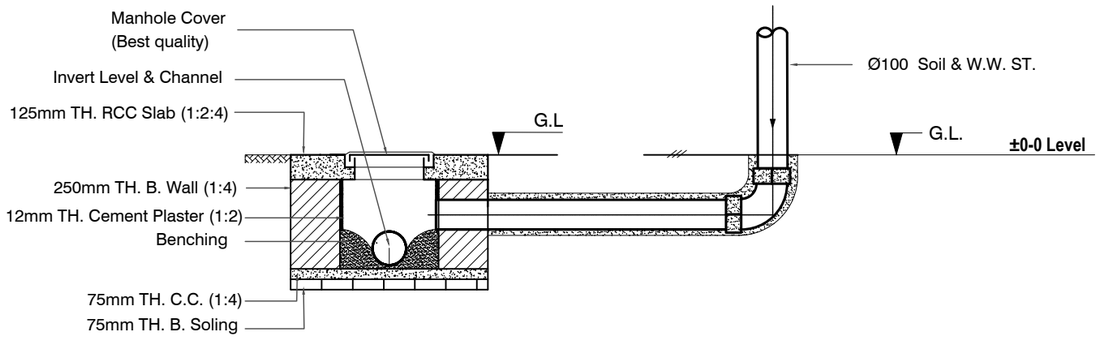
Rainwater drainage layout

**All Levels are in Chart Datum

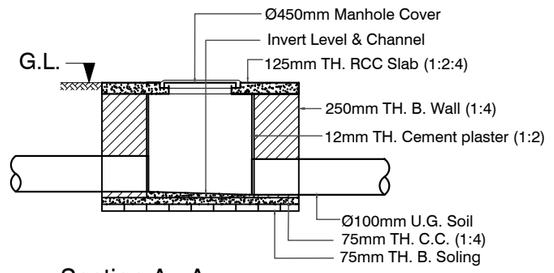
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Rainwater Drainage of Security House		1.
					2.
					3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-D-005

Date: 30-Apr-2025
Status:
Revision: R-00

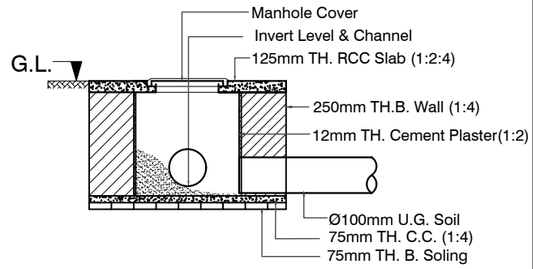
TENDER DRAWINGS



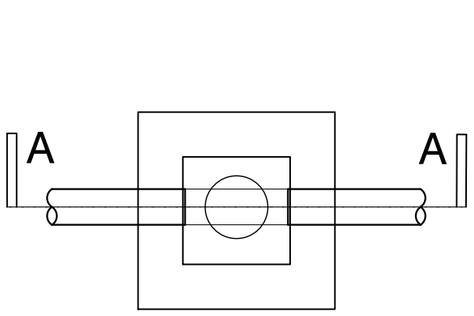
Sec. of S.Stack to
Pits Connection Detail (Typical)



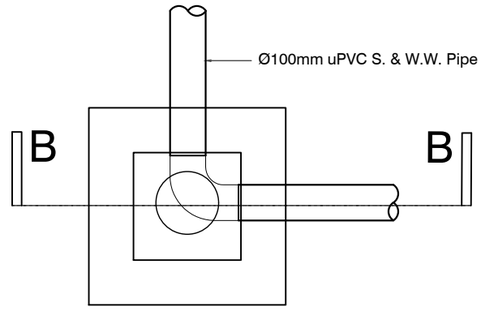
Section A - A
Pits Connection Detail



Section B - B
Pits Connection Detail



Plan of Pits



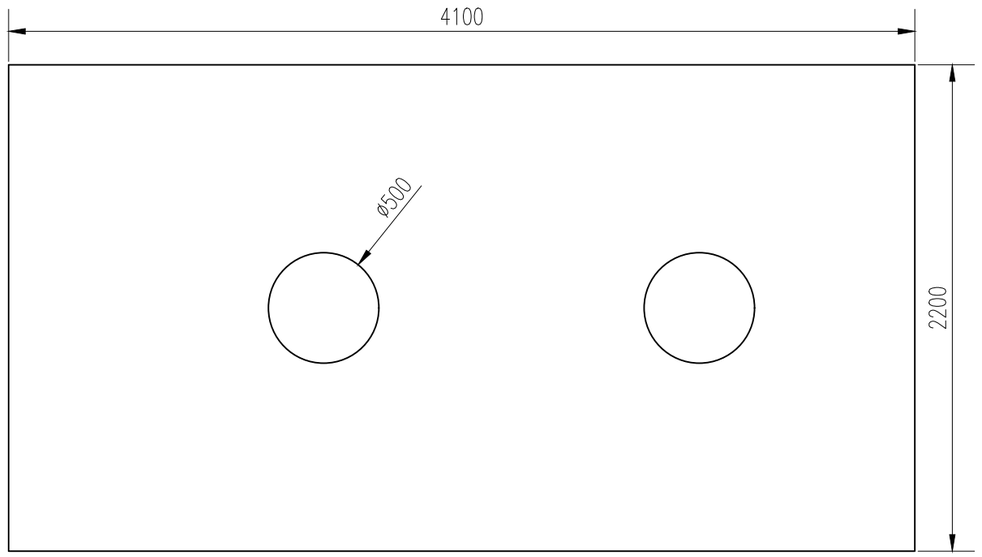
Plan of Pits

**All Levels are in Chart Datum

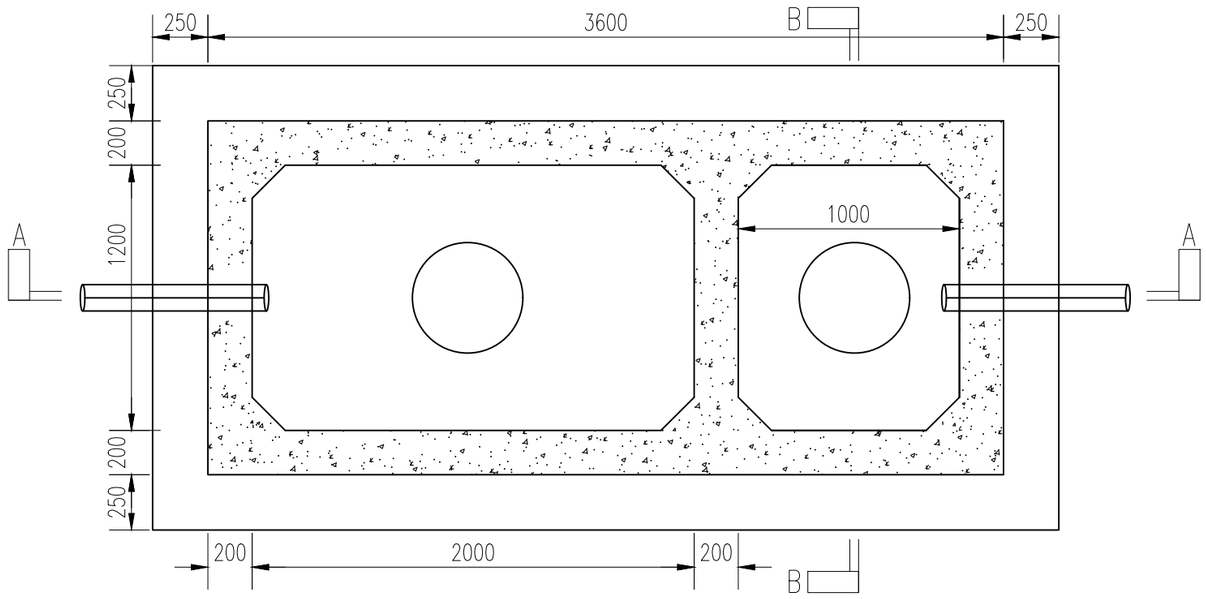
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System SHEET TITLE: Pits Details of Security House	Revision History: 1. 2. 3.
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-006

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



Top View of Septic Tank

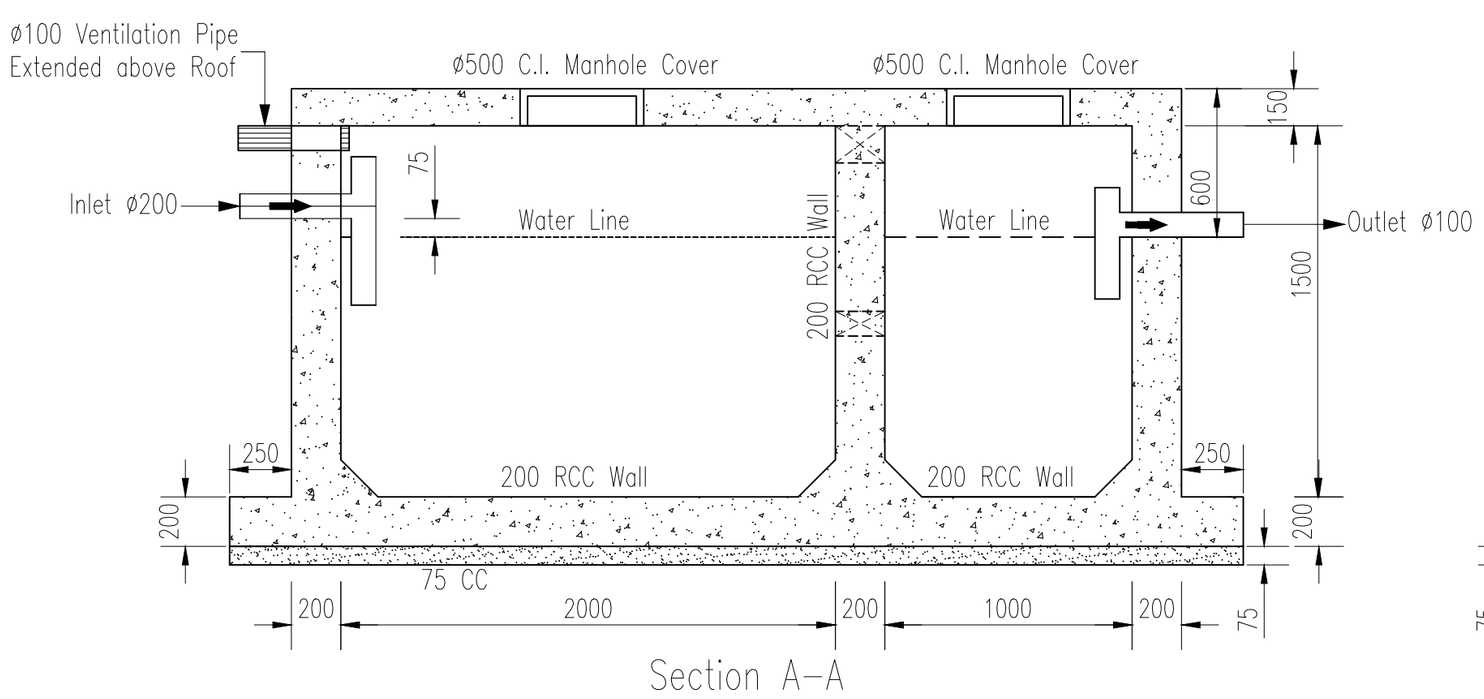


Sectional Plan of Septic Tank

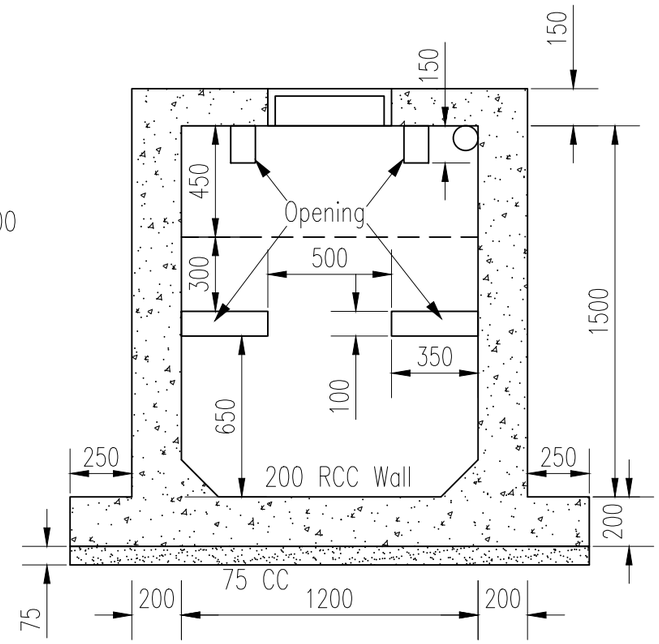
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Septic Tank Plan Details of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-007	

TENDER DRAWINGS



Section A–A

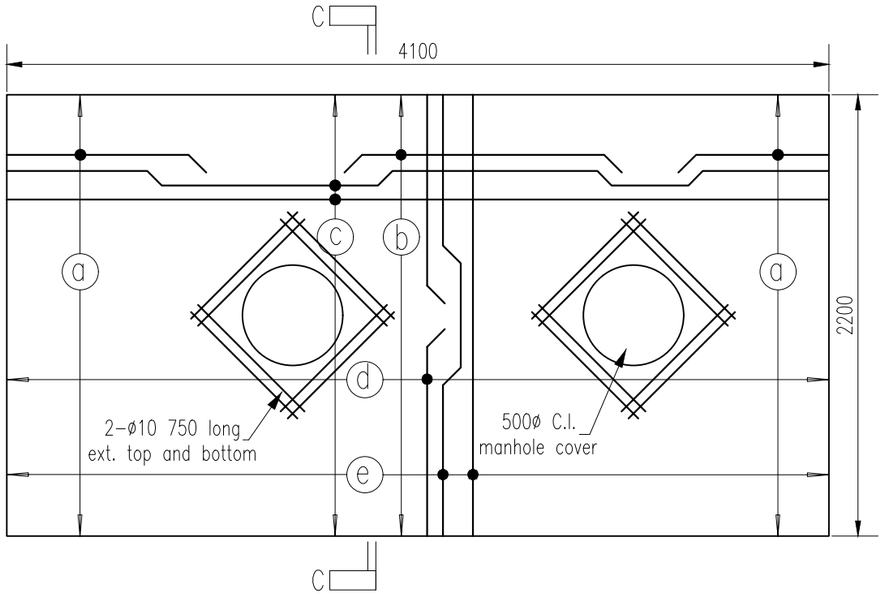


Section B–B

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Septic Tank Section Details of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-008	

TENDER DRAWINGS



Top Slab Reinforcement Detailing

ⓐ 1- ø12 ext.

ⓑ 1- ø10 ext.

ⓒ ø12 @125 c/c alt. ckd.

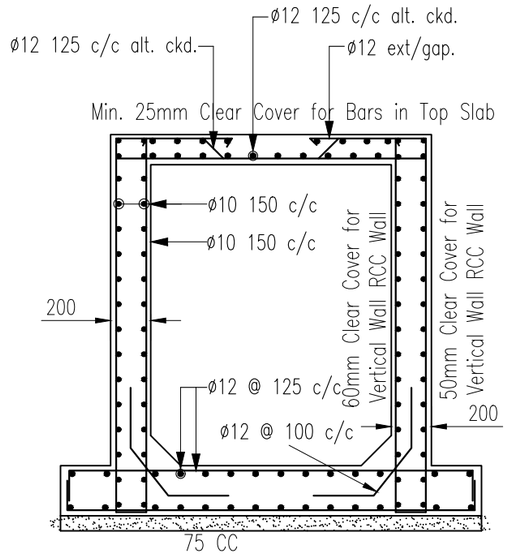
ⓓ ø12 @ 250 c/c

ⓔ ø12 @ 150 c/c alt. ckd.

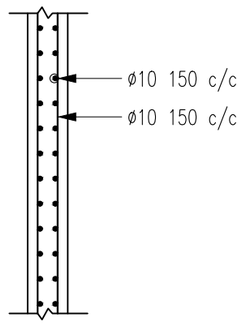
Bottom Slab Reinforcement Detailing

ⓐ ø12 @150c/c Top and Bottom

ⓑ ø12 @150c/c Top and Bottom



Section C-C

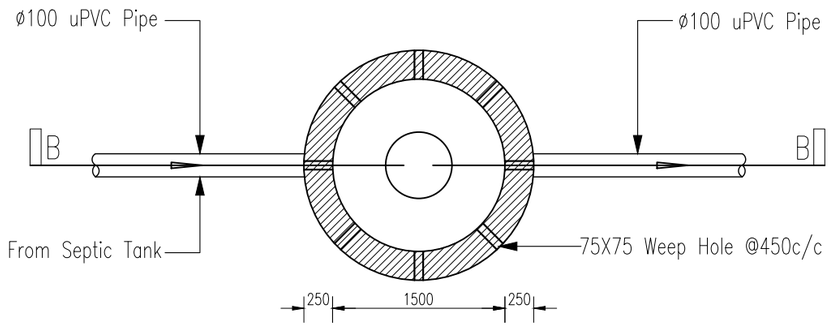


Details of 200 RCC partition wall

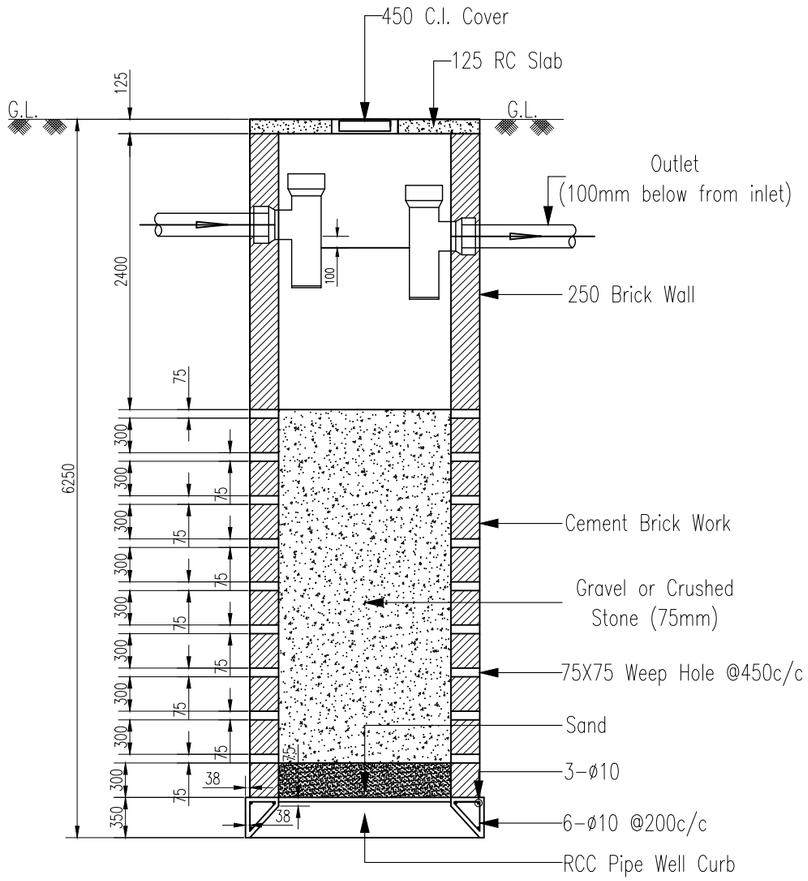
**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Structural Details of Septic Tank of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-009	

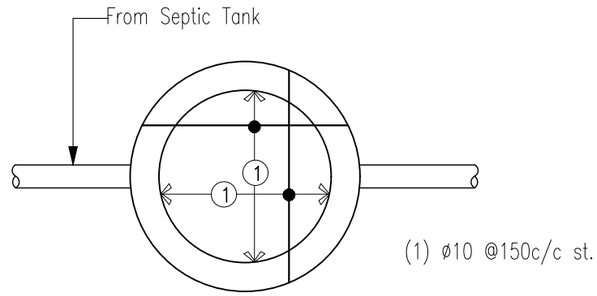
TENDER DRAWINGS



Soakwell



Section B-B

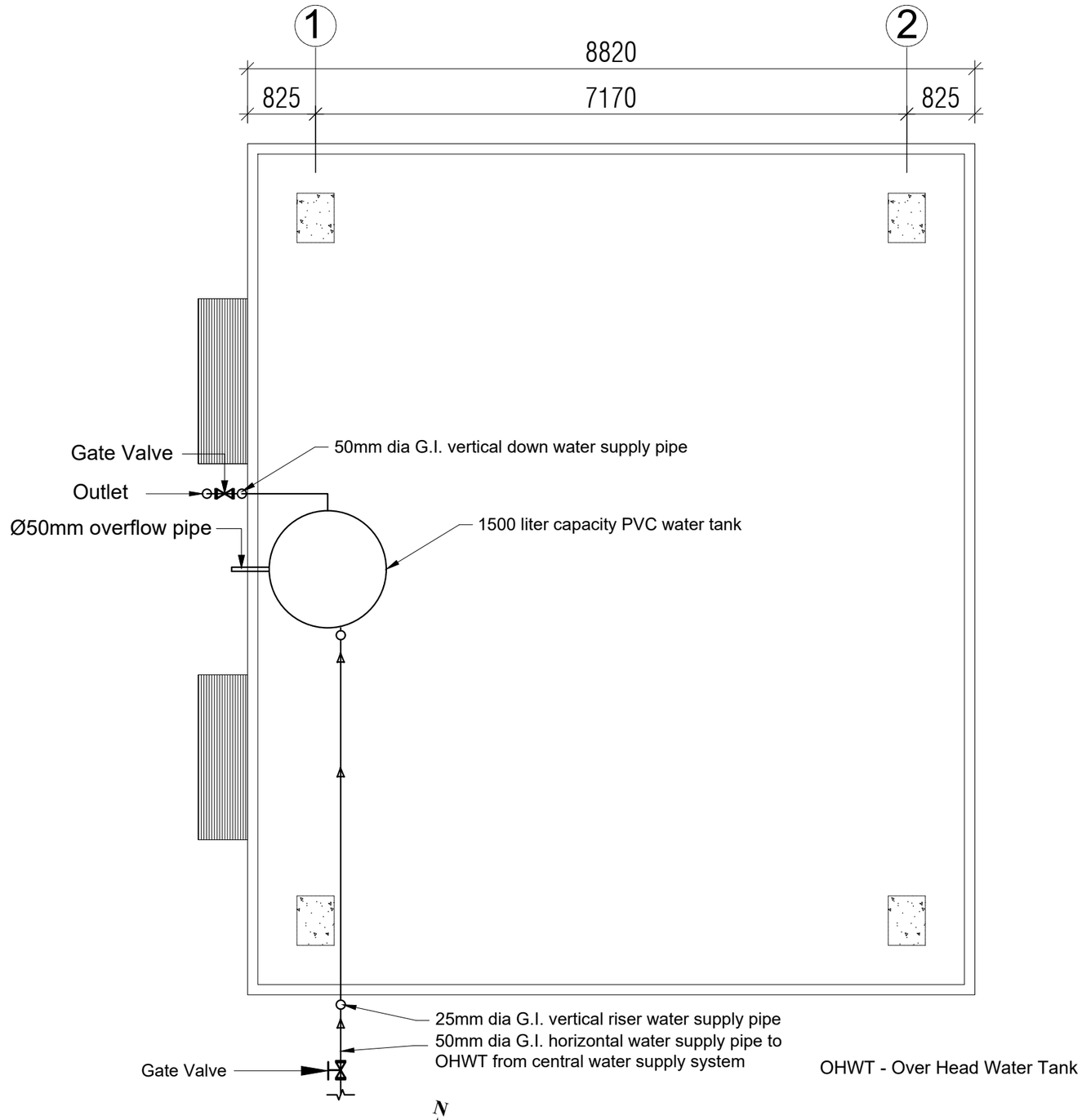


Reinforcement Detailing of Soakwell

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Soakwell Details of Security House	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-010	

TENDER DRAWINGS



Pump & Blasting System

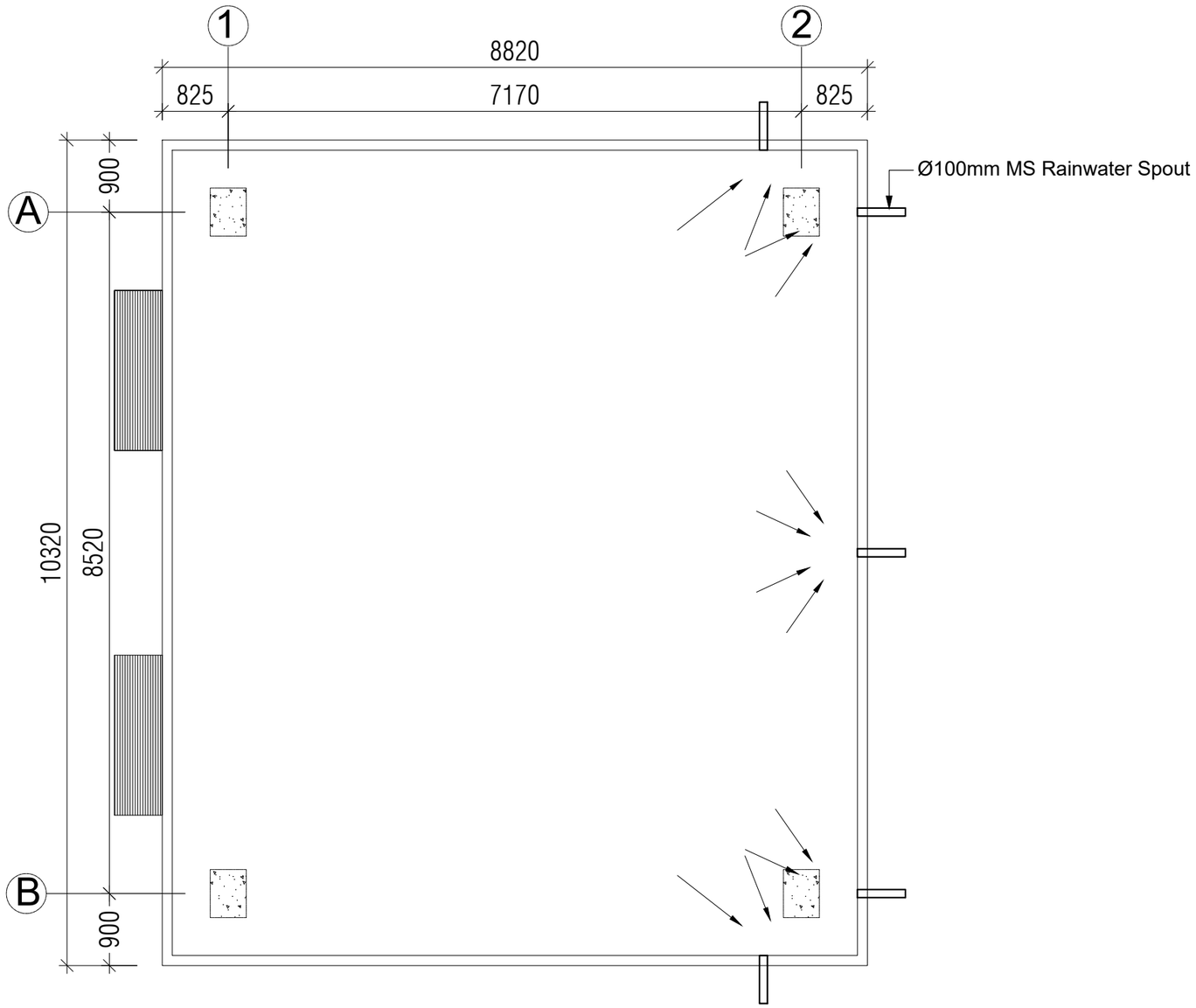
Water supply to OHWT

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System		Revision History:
			SHEET TITLE: Water Supply of Pump & Blasting System		1.
					2.
					3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-08-D-011

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



N

Pump & Blasting System

Rainwater Drainage

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Plumbing and Drainage System of Security House, Pump & Blasting System	Revision History:	
			SHEET TITLE: Rainwater Drainage of Pump & Blasting System	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-08-D-012	

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

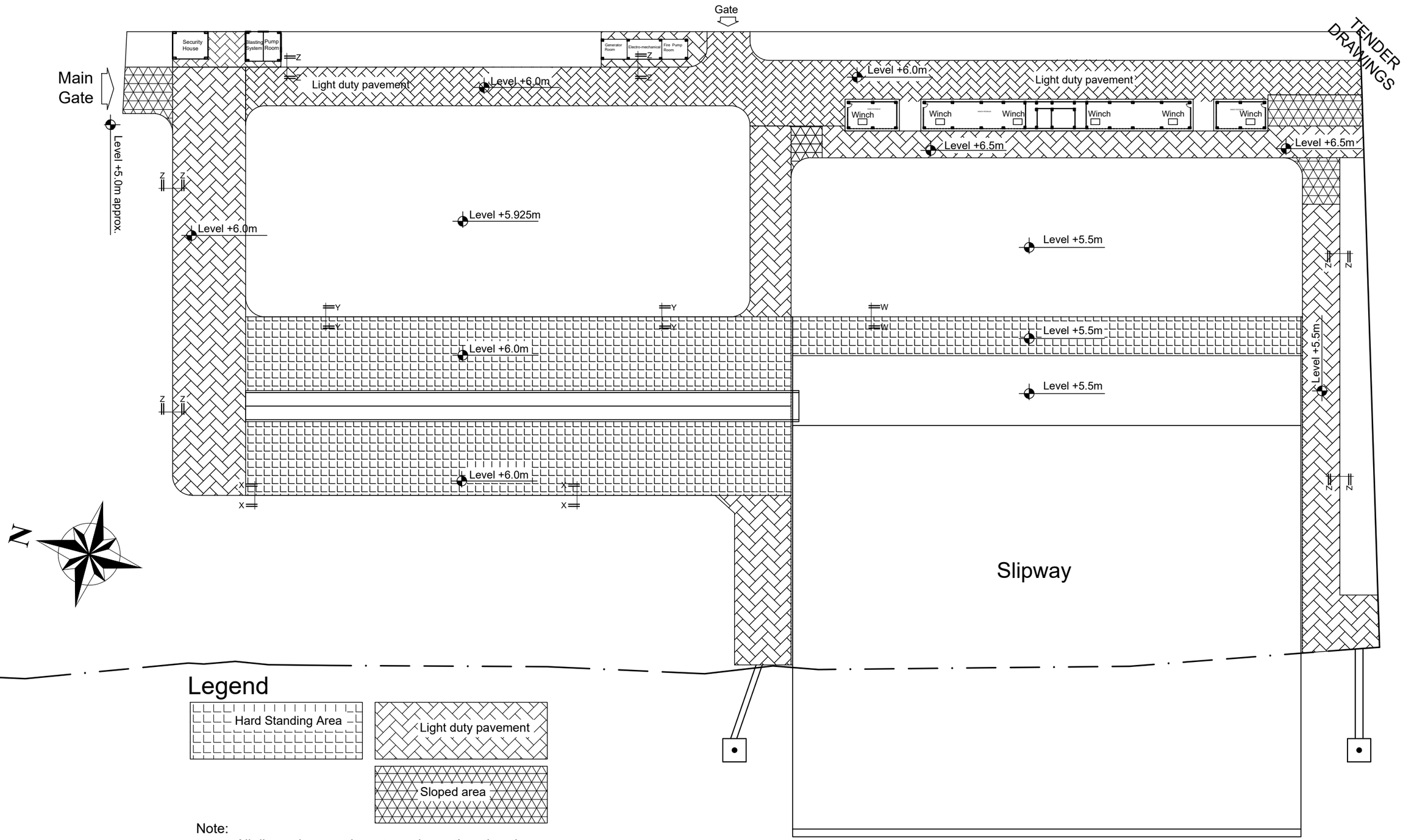
ENGINEERING PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

PAVEMENT DESIGN

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTATION (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

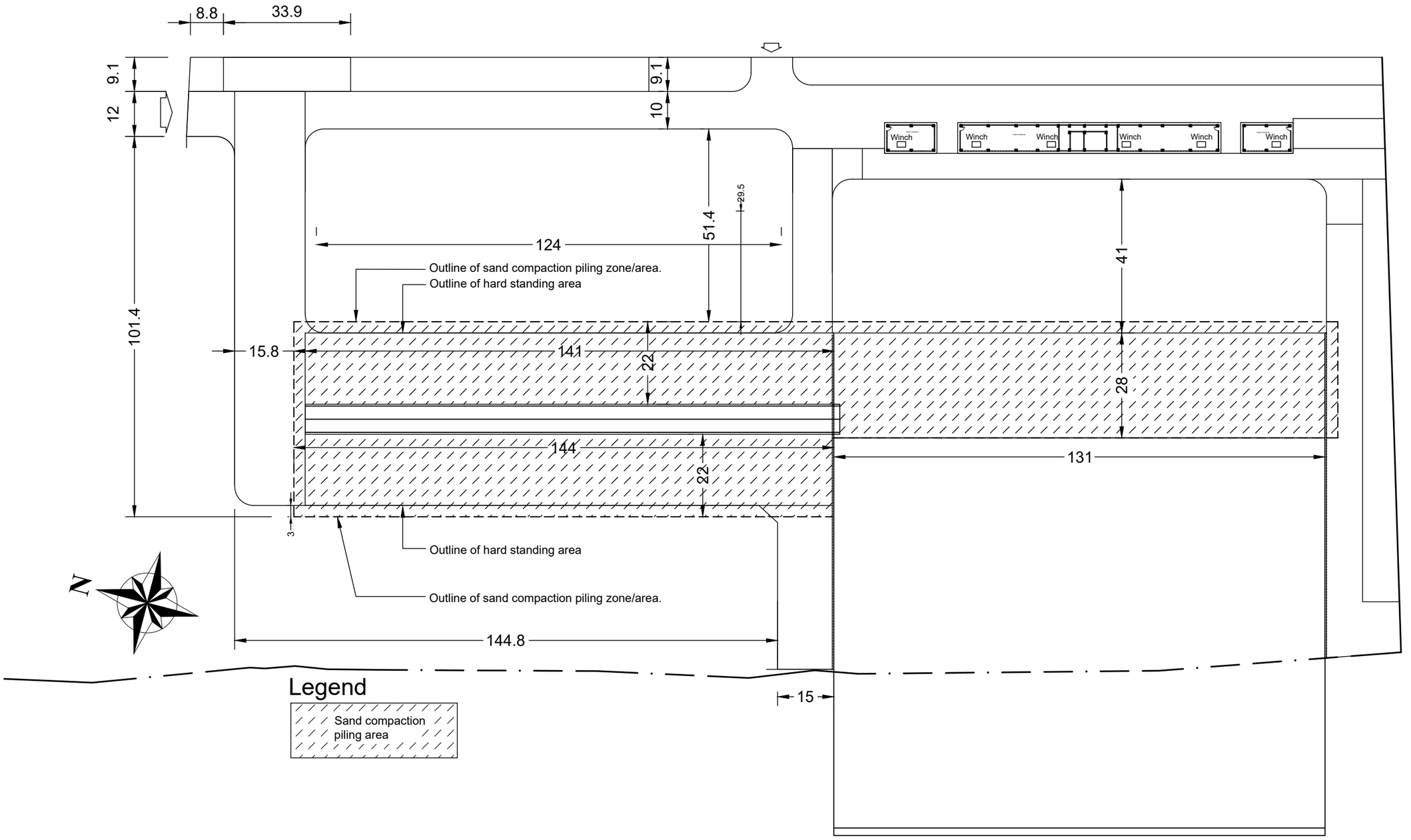


Note:

a. All dimensions are in meter unless otherwise shown.
b. All levels are in Chart Datum
c. Levels shown are of general nature. Actual precise levels may vary a little due to cross slope provided for drainage in open areas.

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT LAYOUT PLAN SHEET TITLE: Layout Plan of Pavement	Revision History: 1. 2. 3.
			CAD BY:	SCALE: AS SHOWN
			Drg No. D-11-A-001	Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT LAYOUT PLAN	Revision History:	
			SHEET TITLE: Sand compaction piling zone	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-11-A-002	

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M.≥0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS		Revision History:
			SHEET TITLE: General Notes 1 of 2		1.
					2.
					3.
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-11-B-001

Revision History: | Date: 30-Apr-2025 | Status: | Revision: R-00

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

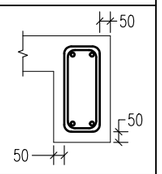
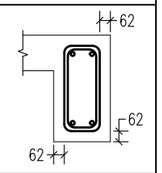
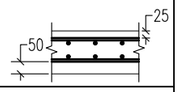
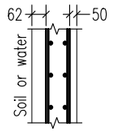
6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

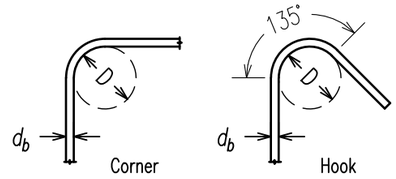
7. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Beam on ground	Top, side & bottom	50mm	
	In contact with soil or water	62mm	
Slab on ground	Top and bottom	25mm and 50mm	
R.C.C wall below ground	In contact with soil or water	62mm	
	Other	50mm	

8. BAR BENDING PIN DIAMETER FOR HOOKS AND L–BENDS

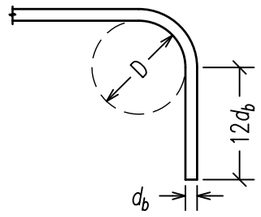
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement

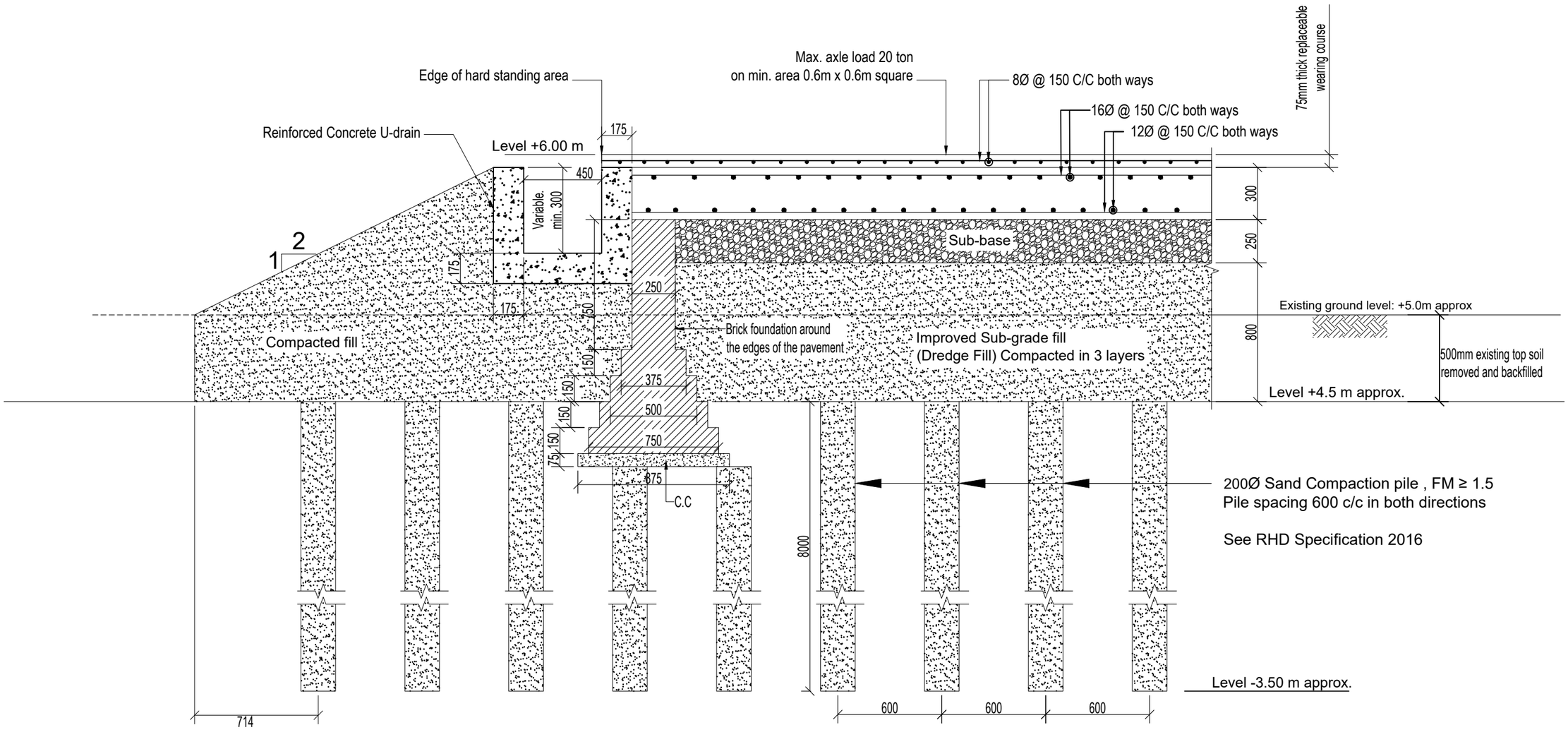


D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS	Revision History:	
			SHEET TITLE: General Notes 2 of 2	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM	SCALE: AS SHOWN	Drg No. D-11-B-002

TENDER DRAWINGS

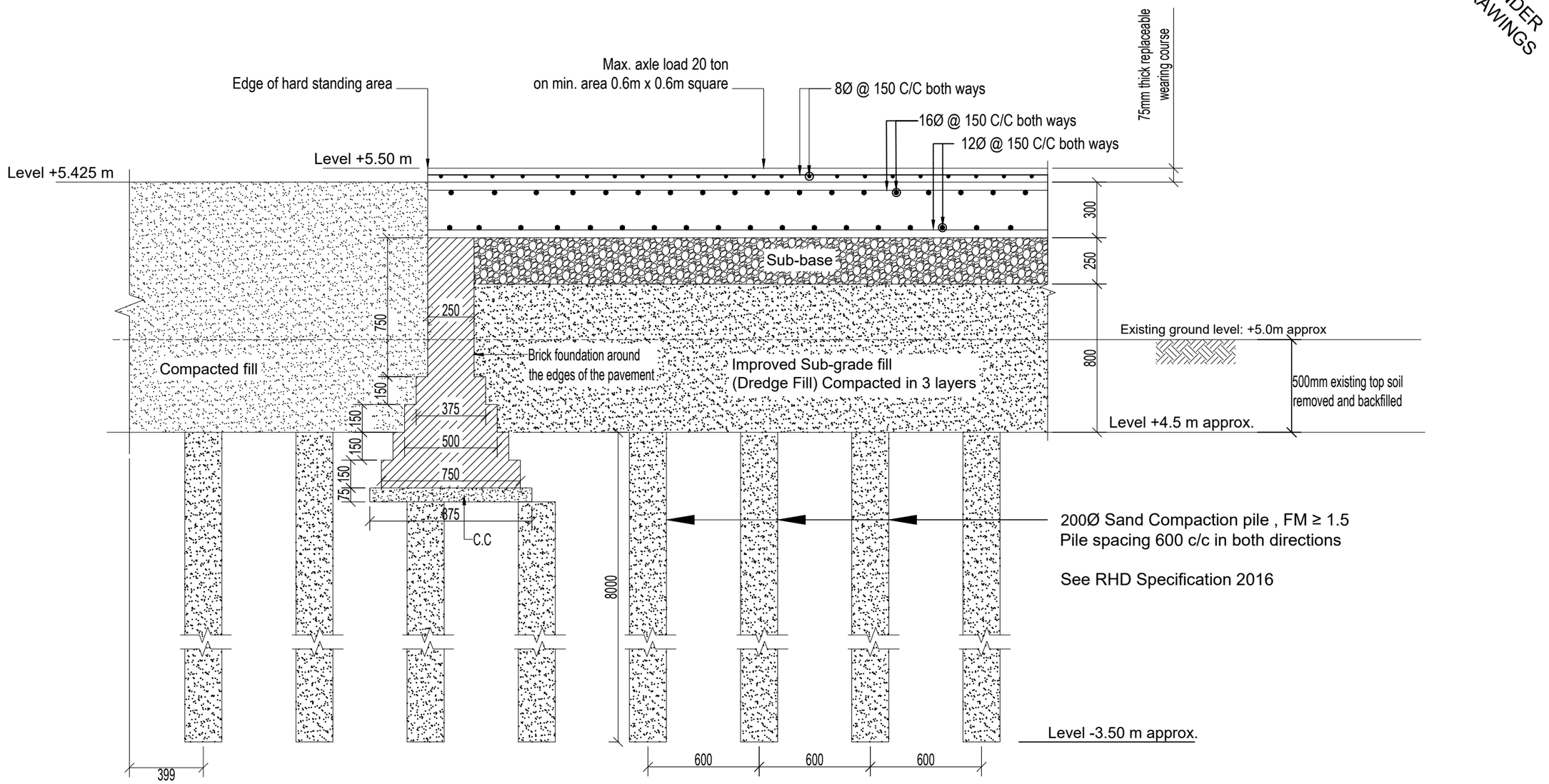


Typical section of Hard Standing Area
Section X-X

(Please see sheet D-11-A-001 for the locations of Sec. X-X)

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS	Revision History:	
			SHEET TITLE: Typical Details of Heavy Duty Pavement - 1 of 3	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-11-B-003	

TENDER DRAWINGS



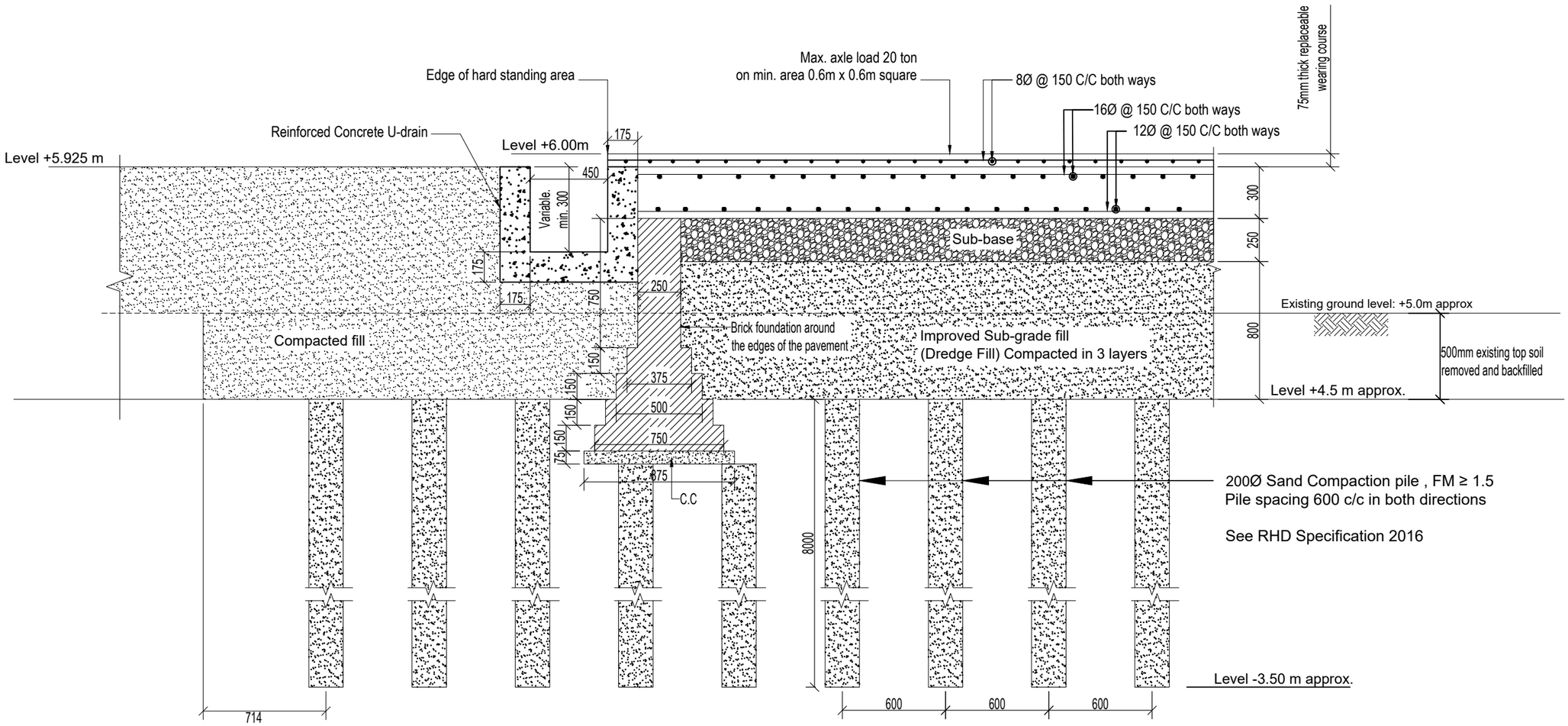
Typical section of Hard Standing Area
Section W-W

(Please see sheet D-11-A-001 for the locations of Sec. W-W)

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS SHEET TITLE: Typical Details of Heavy Duty Pavement - 2 of 3 CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-B-004

Date: 30-Apr-2025
Status:
Revision: R-00

TENDER DRAWINGS



Typical section of Hard Standing Area
Section Y-Y

(Please see sheet D-11-A-001 for the locations of Sec. Y-Y)

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS SHEET TITLE: Typical Details of Heavy Duty Pavement - 3 of 3 CAD BY: MD. ABDUL HALIM SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-B-005

Date: 30-Apr-2025
Status:
Revision: R-00

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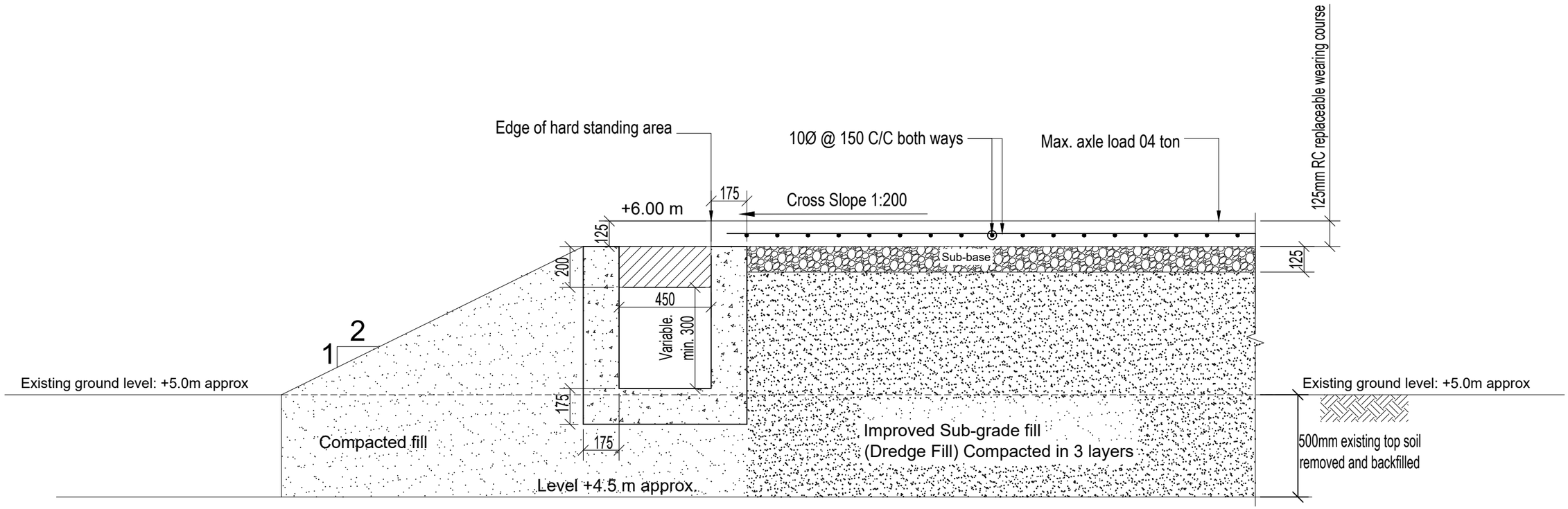
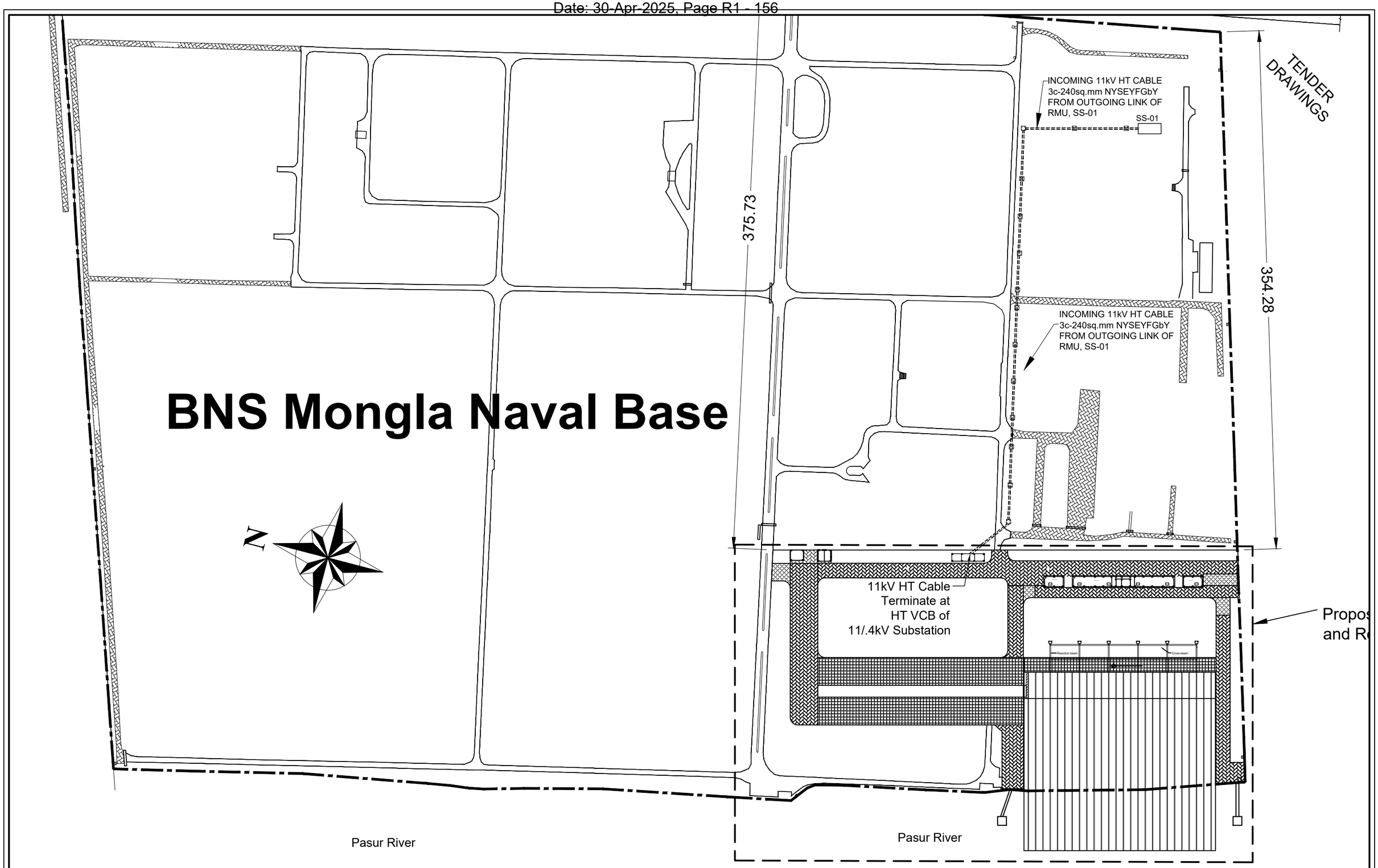


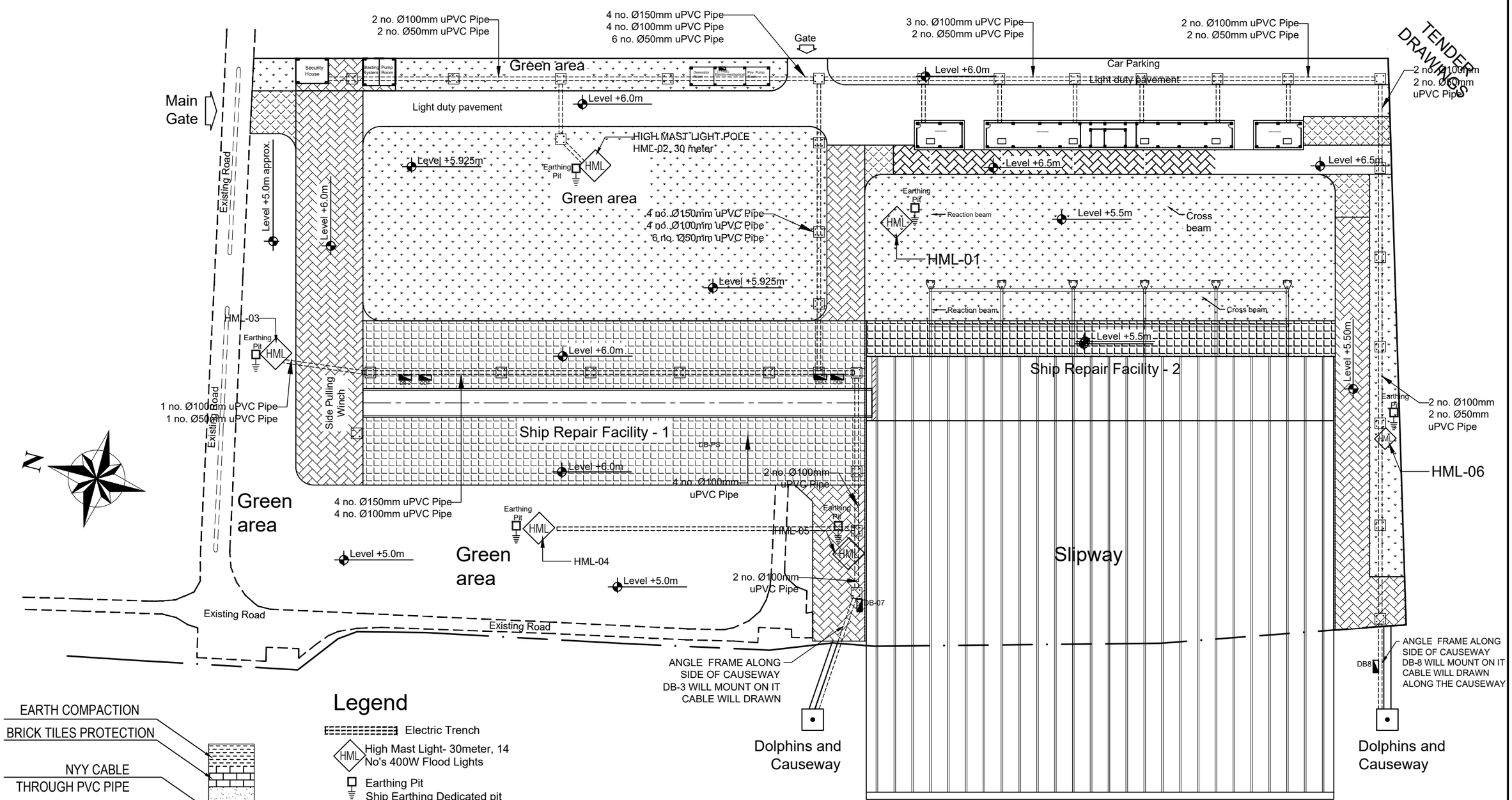
Typical section of light duty pavement
Section Z-Z

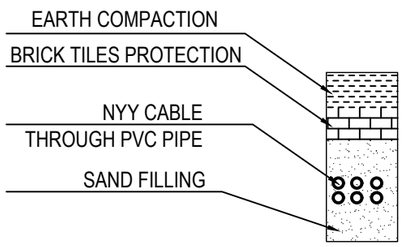
(Please see sheet D-11-A-001 for the locations of Sec. Z-Z)

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DETAILS	Revision History:	
			SHEET TITLE: Typical Details of Light Duty Pavement	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: MD. ABDUL HALIM / SCALE: AS SHOWN	Drg No. D-11-B-006	



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Main Incoming HT Cable Line from Existing SS-1, Source-01 BNS Mongla CAD BY: SCALE: AS SHOWN	Revision History: 1. Date: 30-Apr-2025 2. Status: 3. Revision: Drg No. D-11-C-001





TRENCH DETAILS CROSS SECTION FOR LAYING NYY CABLE

Legend

- Electric Trench
- HML — High Mast Light- 30meter, 14 No's 400W Flood Lights
- Earthing Pit
- Ship Earthing Dedicated pit

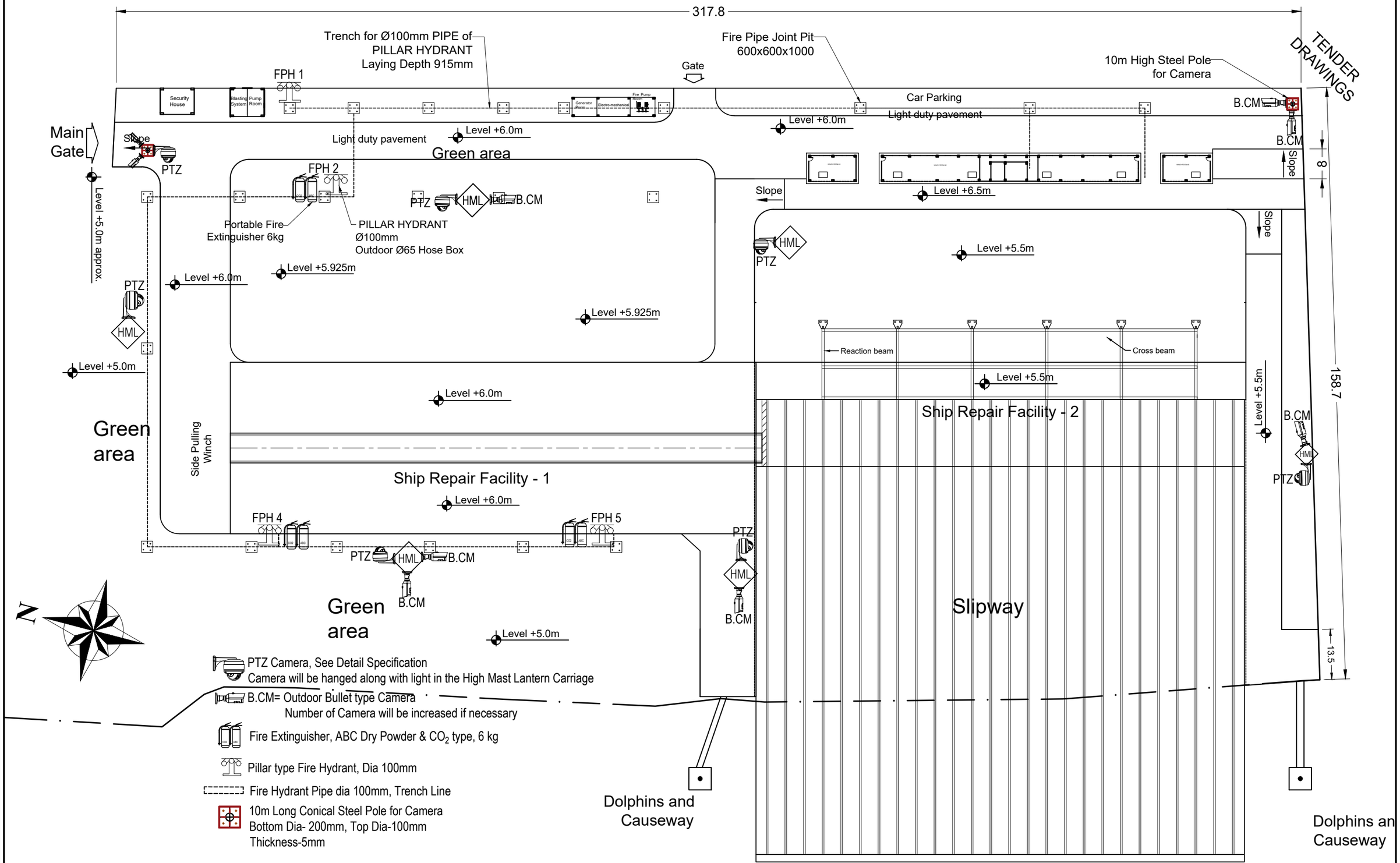
NOTE FOR HIGH MAST POLE POWER CONNECTION:

1. HML-01 & 06 POWER WILL BE FROM WINCH CONTROL HOUSE
2. HML-02 POWER WILL BE FROM SECURITY HOUSE
3. HML-03 POWER WILL BE FROM OPEN BERTH DB-1
3. HML-04 POWER WILL BE FROM OPEN BERTH DB-3
4. HML-05 POWER WILL BE FROM OPEN BERTH DB-6
5. REQUIRED POWER CABLE FOR HML-06 WILL BE 1C-4x25 sq.mm NYY

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Electrical Trench Route and High Mast Lighting of Repair Facility. CAD BY: SCALE: AS SHOWN

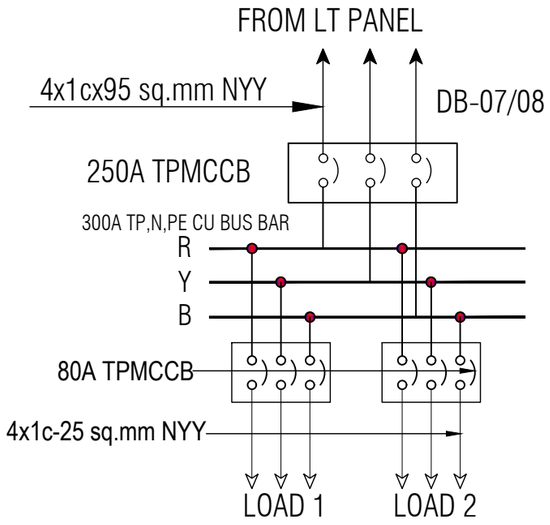
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:

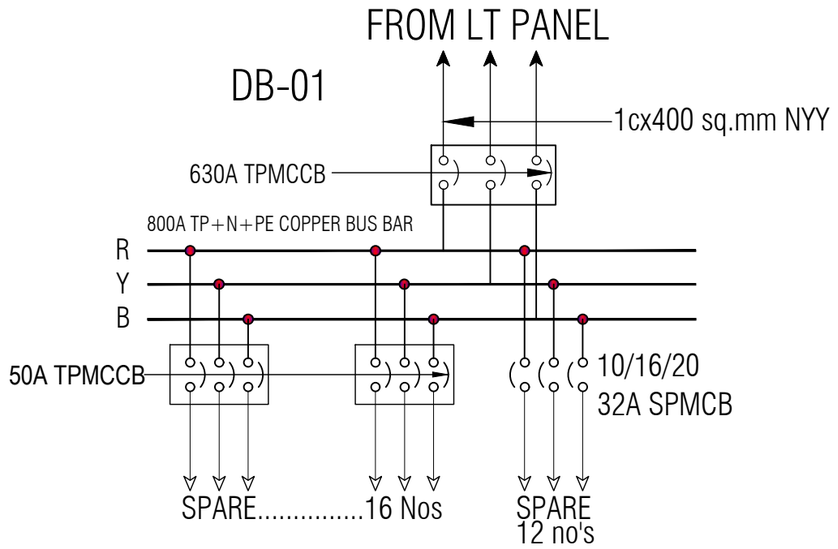
Drg No. D-11-C-002

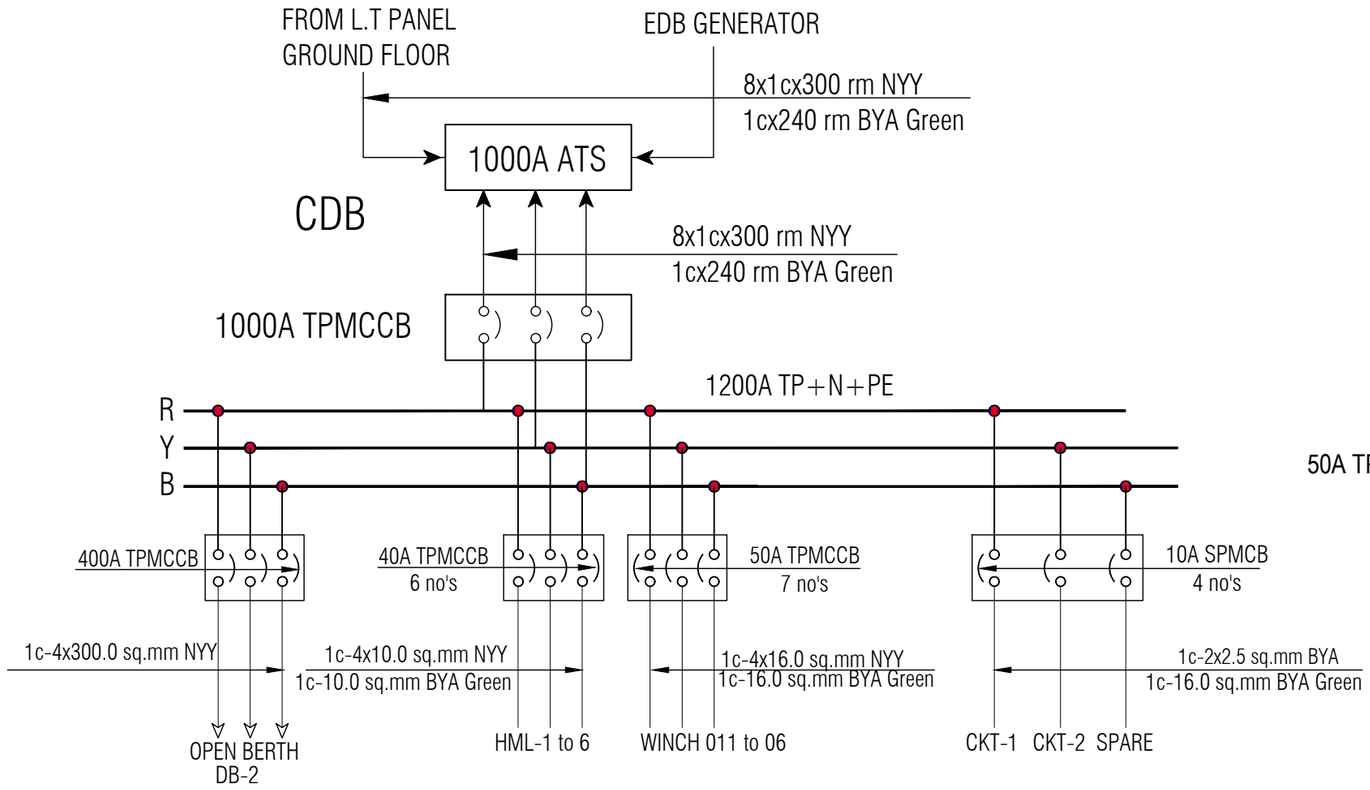


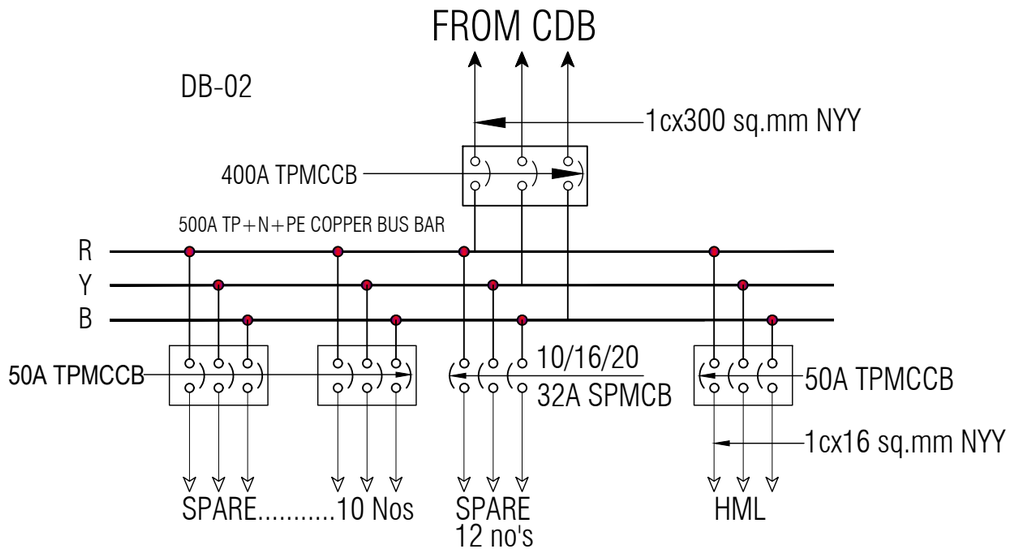
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Fire Pillar Hydrant and CCTV Fixture Details for Repair Facility. CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-C-003
				Date: 30-Apr-2025 Status: Revision:

TENDER DRAWINGS









PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Single Line Diagram of Electrical Distribution Boards on Pavement. CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-C-004	Date: 30-Apr-2025 Status: Revision:

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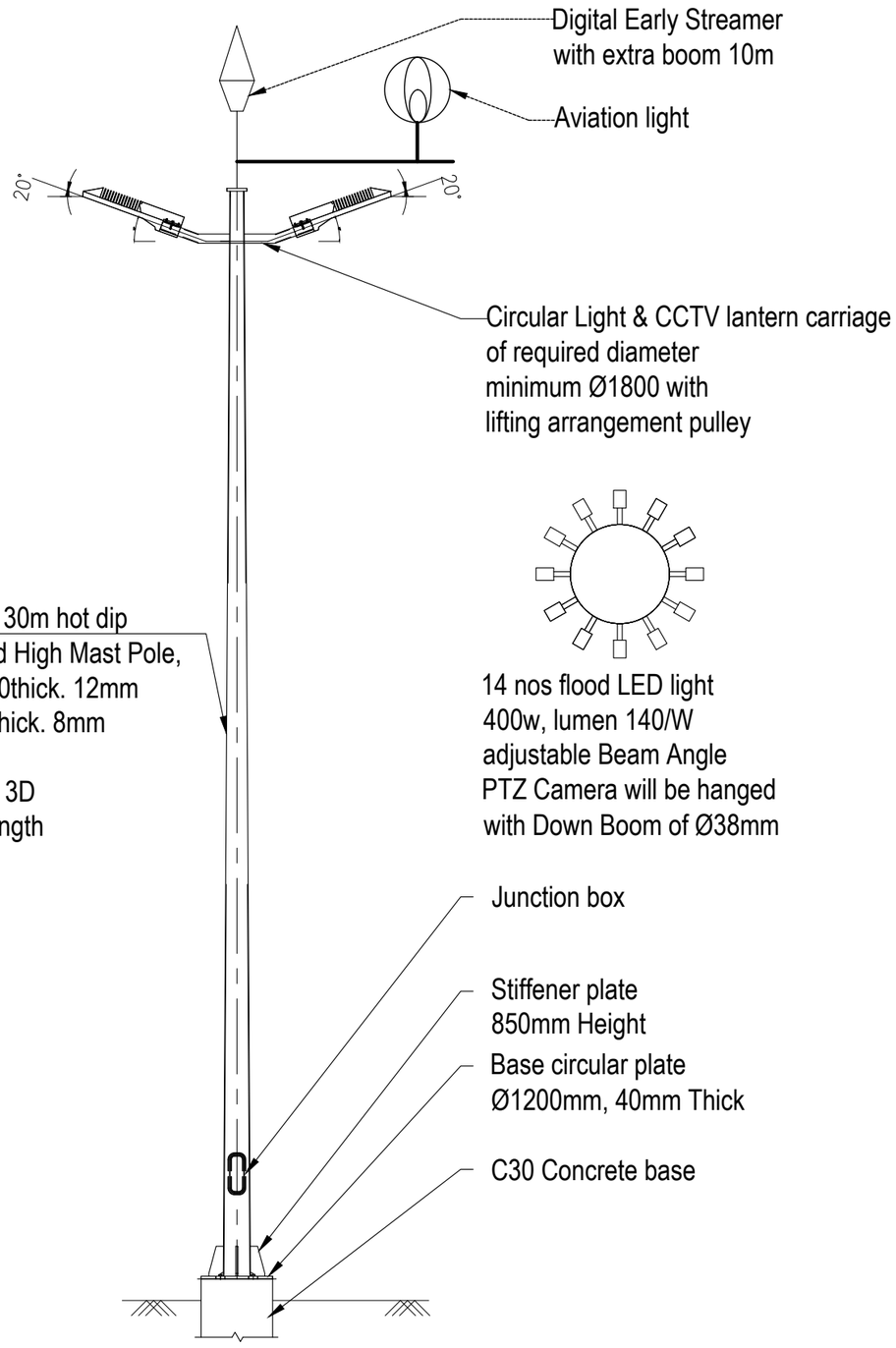
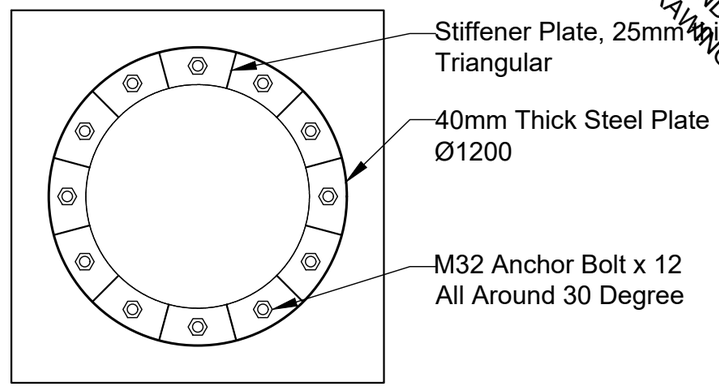
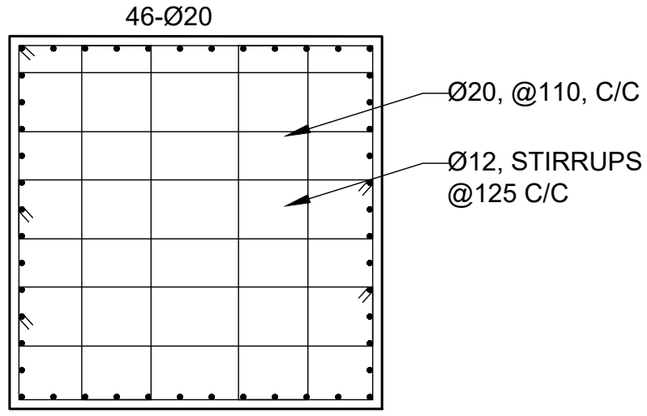
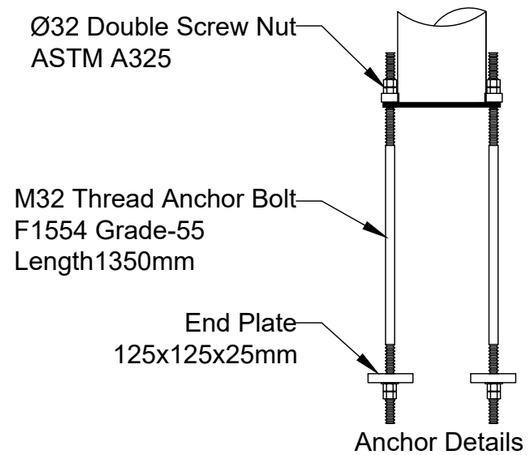






High Mast top Base,
above pile cap

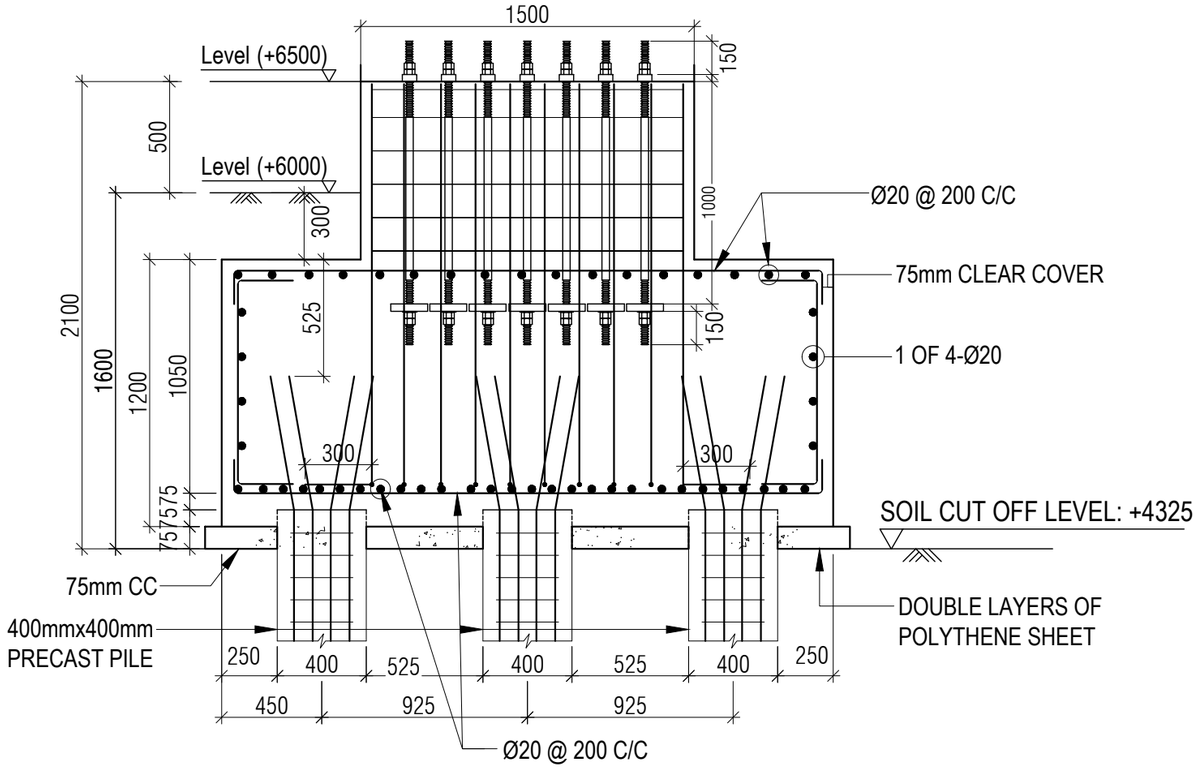


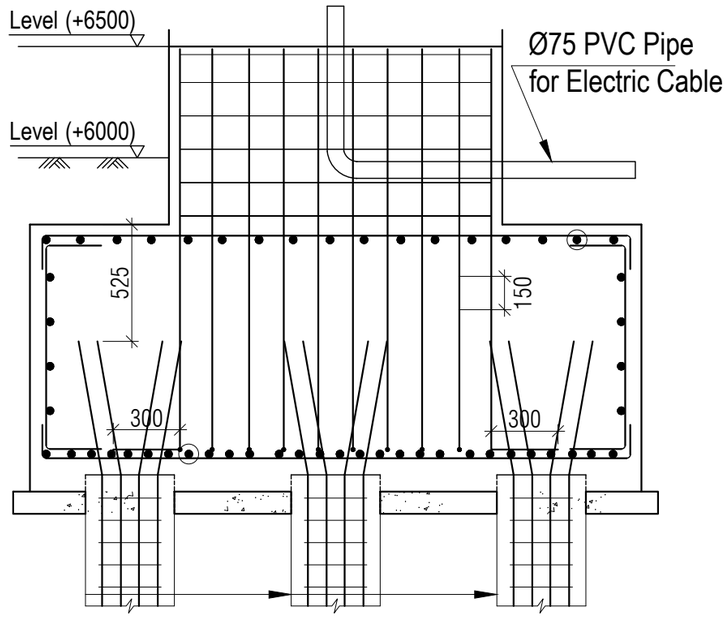
Anchor Details

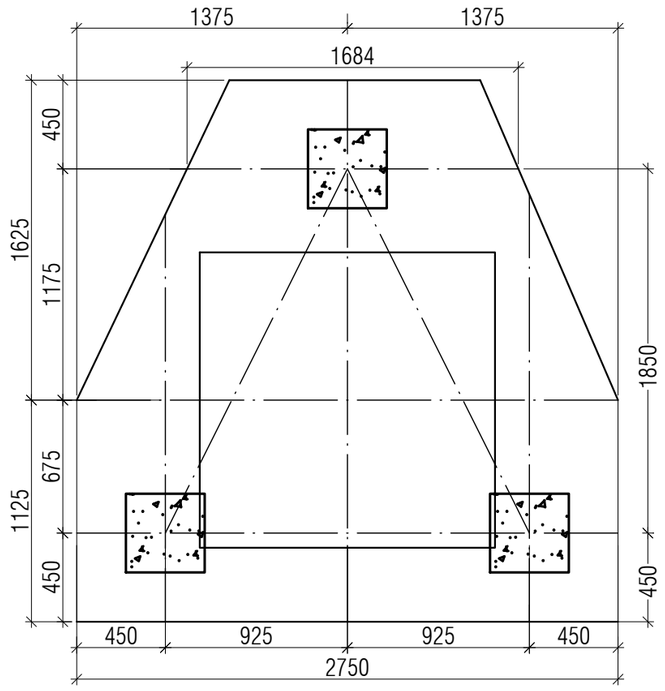
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Hight Mast Pole details CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-C-05

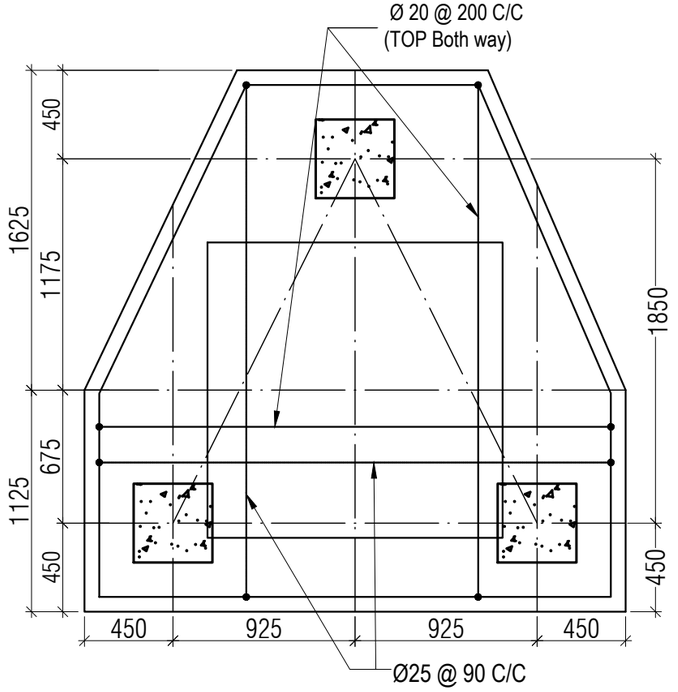
Date: 30-Apr-2025
Status:
Revision:

TENDER DRAWINGS







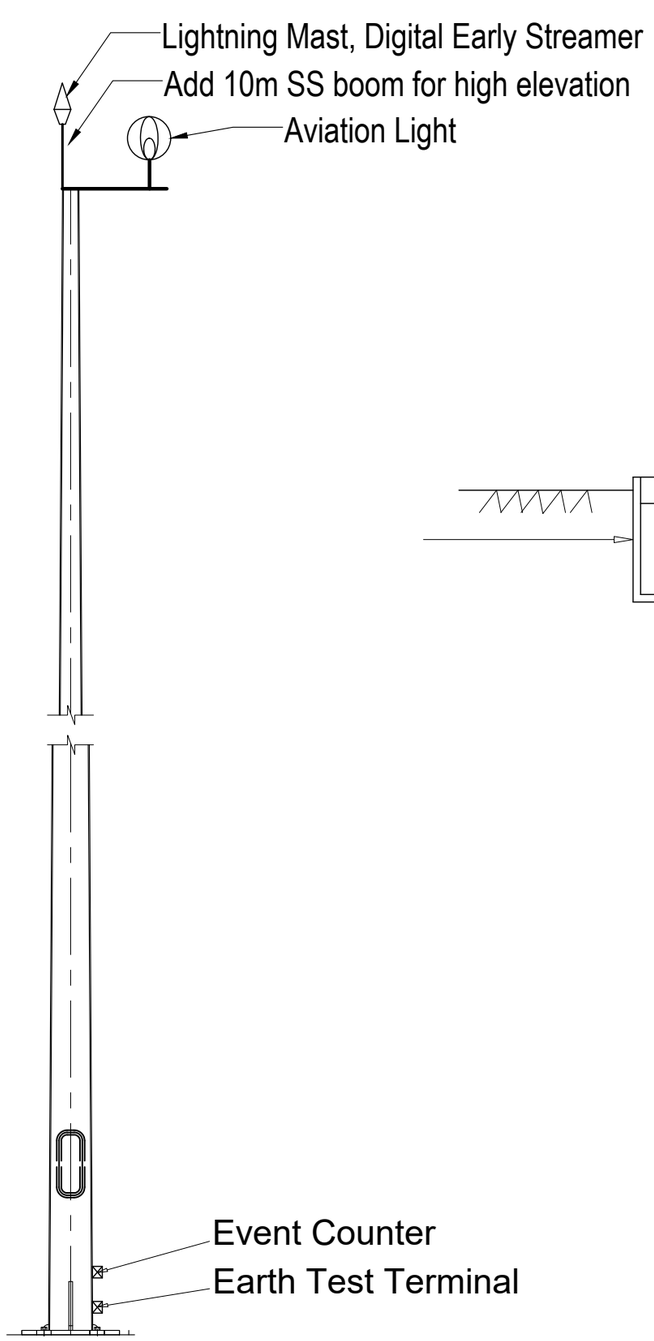


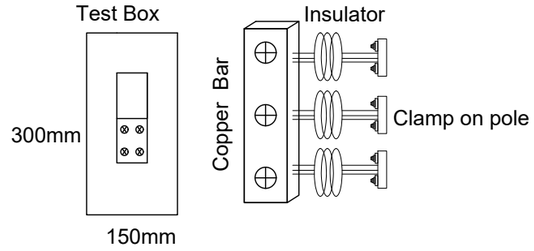
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Hight Mast Pole Structural Details CAD BY: SCALE: AS SHOWN

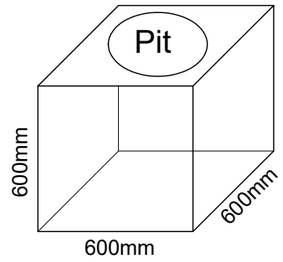
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:

Drg No. D-11-C-006

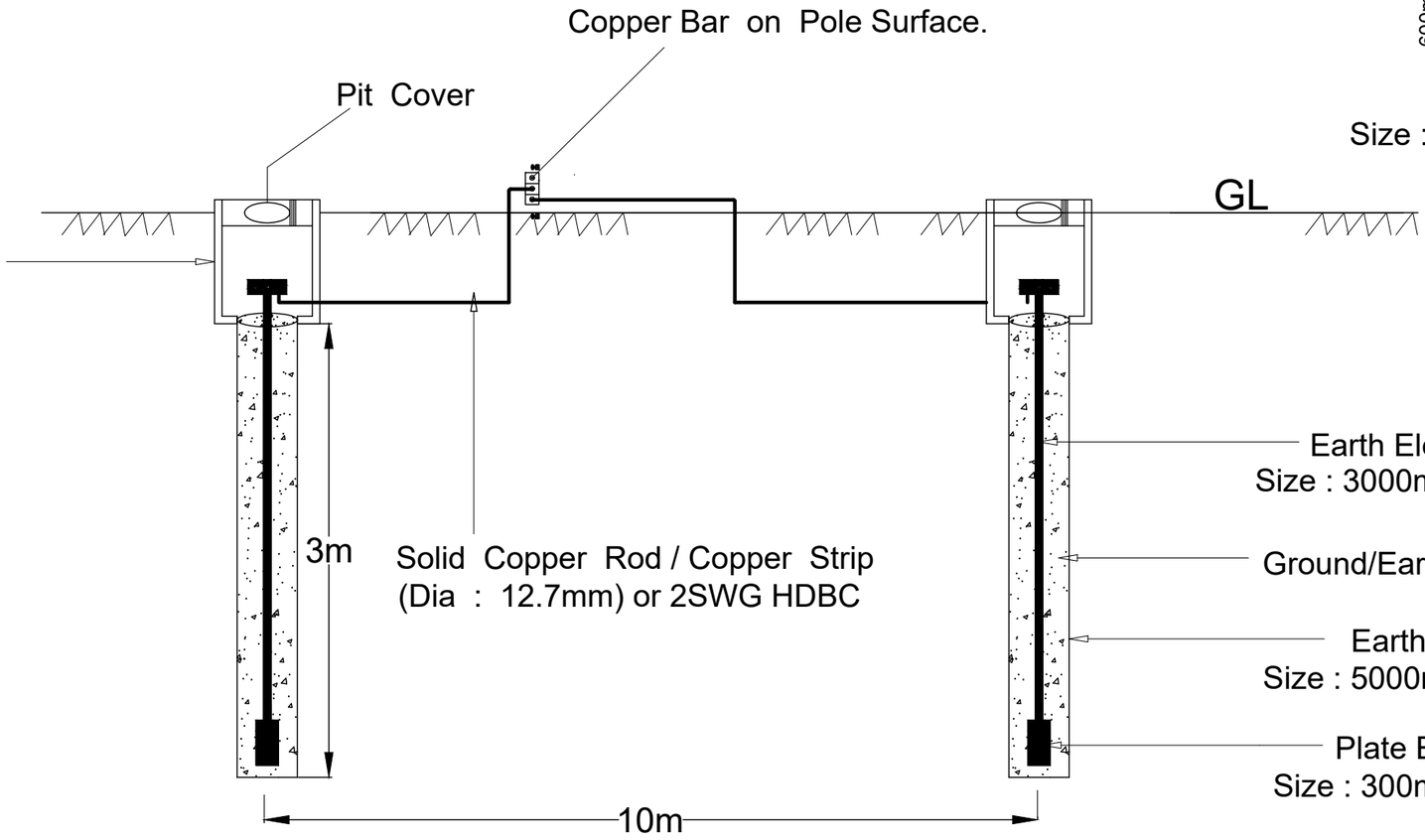
TENDER DRAWINGS





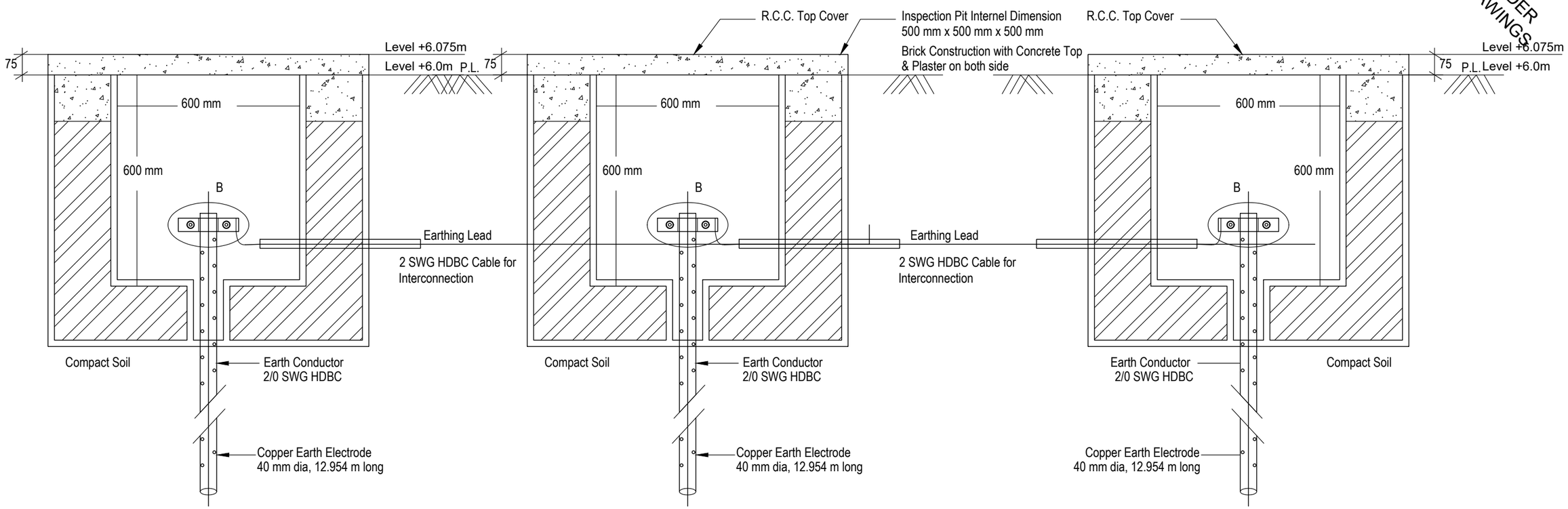


Size : 600mmx600mmx600mm



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement	Revision History:	
			SHEET TITLE: Single Line Diagram of Electrical Distribution Boards, Open Repair Facility.	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision:
			CAD BY: / SCALE: AS SHOWN	Drg No. D-11-C-007	

TENDER DRAWINGS



Detail

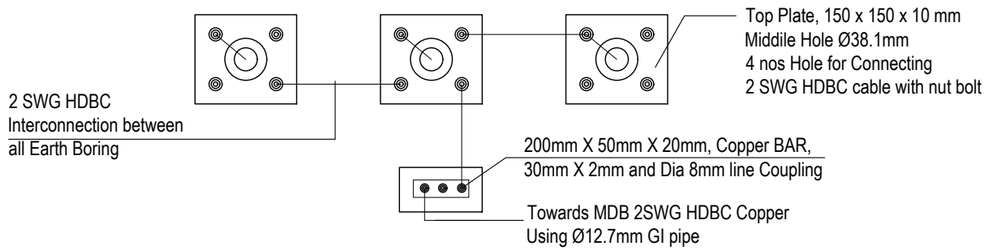
Inspection Pit, Earth Electrode
For System Earthing

Detail

Inspection Pit, Earth Electrode
For System Earthing

Detail

Inspection Pit, Earth Electrode
For System Earthing



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement		Revision History:	
			SHEET TITLE: System and Body Earthing Details for High Mast Pole and Distribution Board of Open Repair Facility		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision:
			CAD BY:	SCALE: AS SHOWN	Drg No. D-11-C-008	

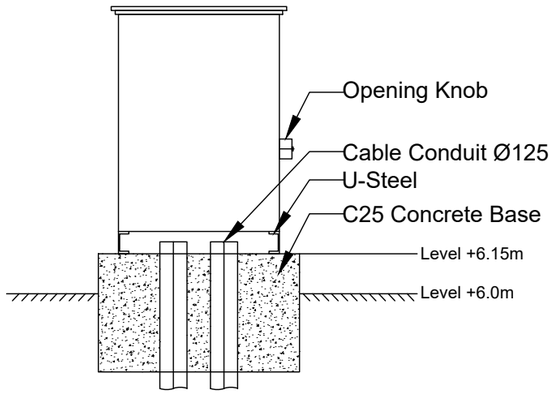
Description:
1. Number of shore electrical boxes: 6

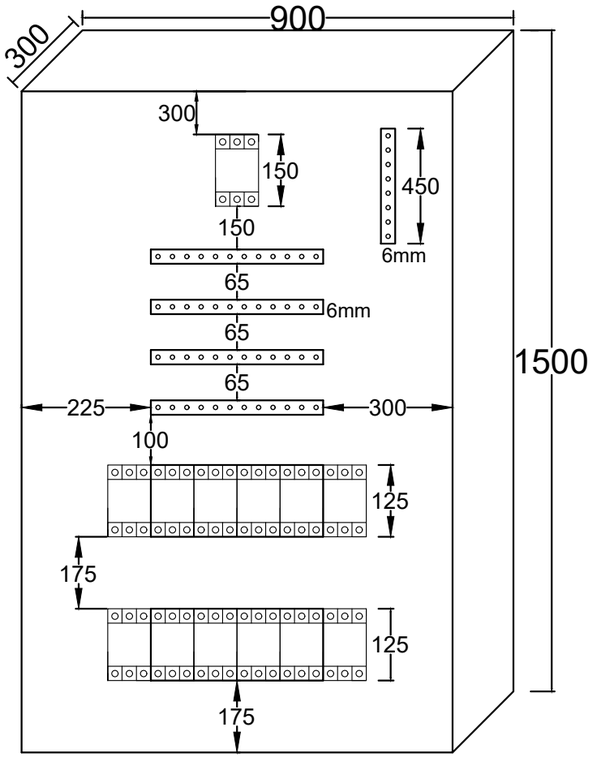
Technical parameters:
A. Rated voltages: ac 400v
B. Rated current: ac 180a,
C. Protection class: box ip66, socket ip56;

2. The power supply side of the shore power box is provided with interlock protection, and only one voltage is allowed. a mechanical interlock is arranged between the circuit breaker and the socket to ensure that the plug is not plugged in or pulled out.

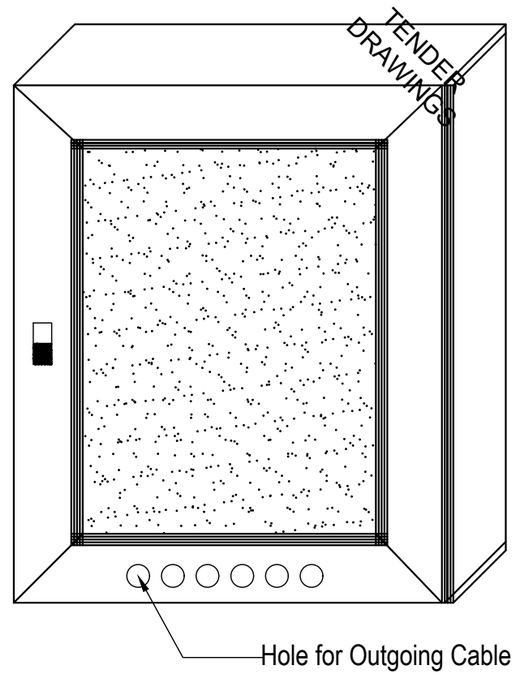
3. The box is made of 16 swg gp sheet steel and sprayed with plastic, the thickness is not less than 2.5 mm, it is waterproof and dustproof, anti-condensation and anti-salt-fog corrosion.

4. Water-proof power indicator lamp and voltmeter for shore power box, aluminum nameplate with box number on top of front door, aluminum nameplate with main electrical parameters on outlet terminal.

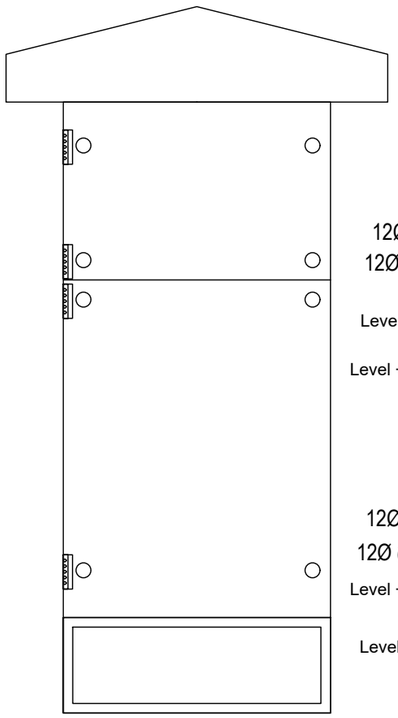




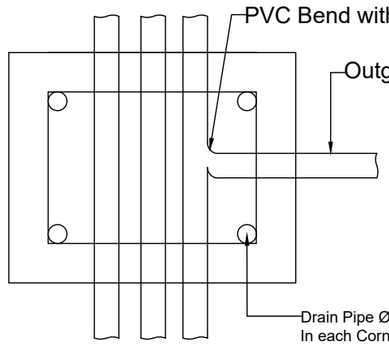
Schematic Diagram Outdoor Distribution Board (IP66)

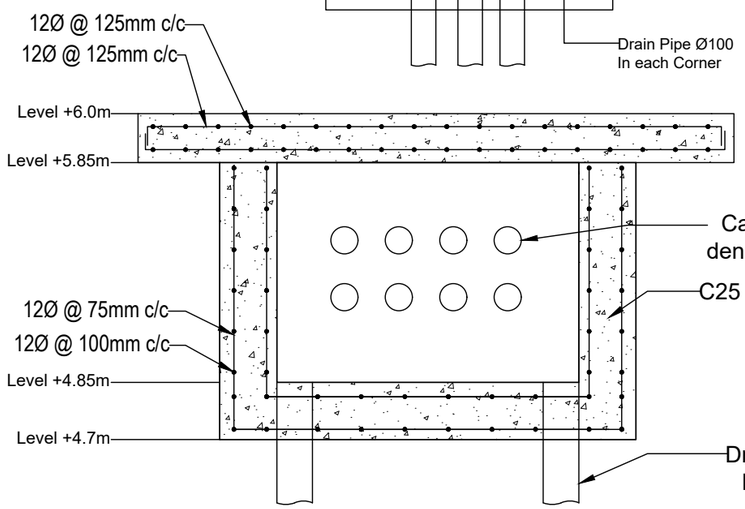


Inside Panel Diagram of Outdoor DB

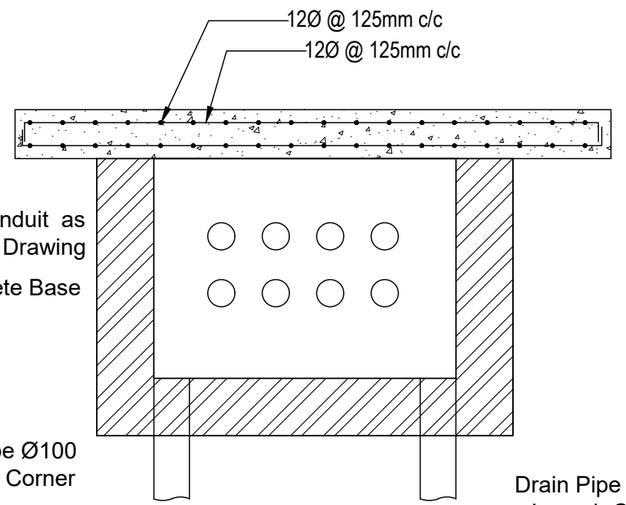


Outer Shade Box for Electric DB

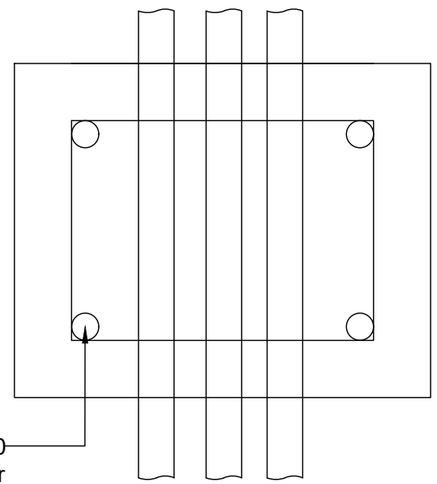




Electric Pit at Hard Standing Area



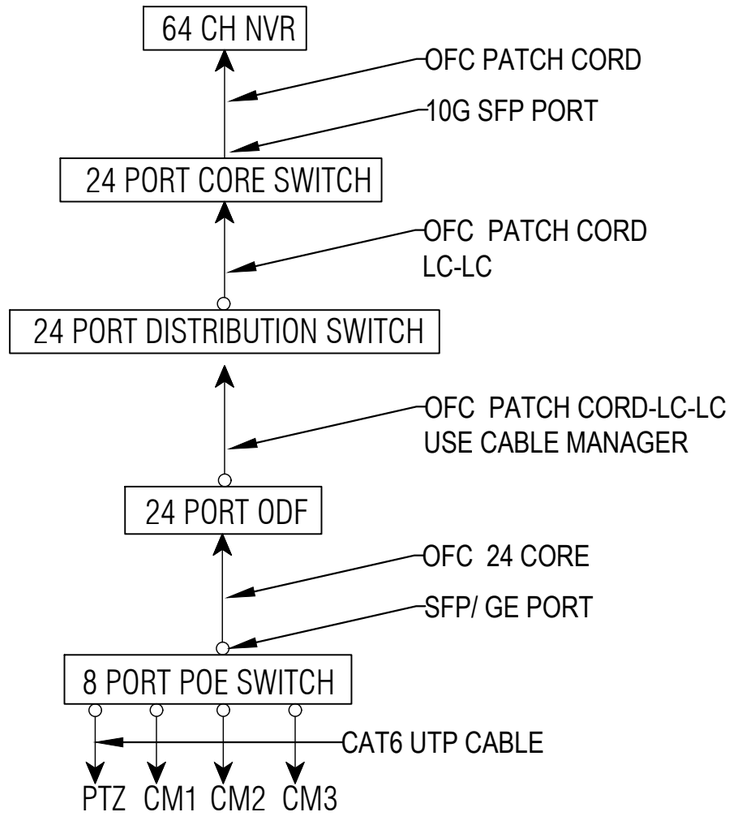
Electric Pit at Green and Light Duty Pavement



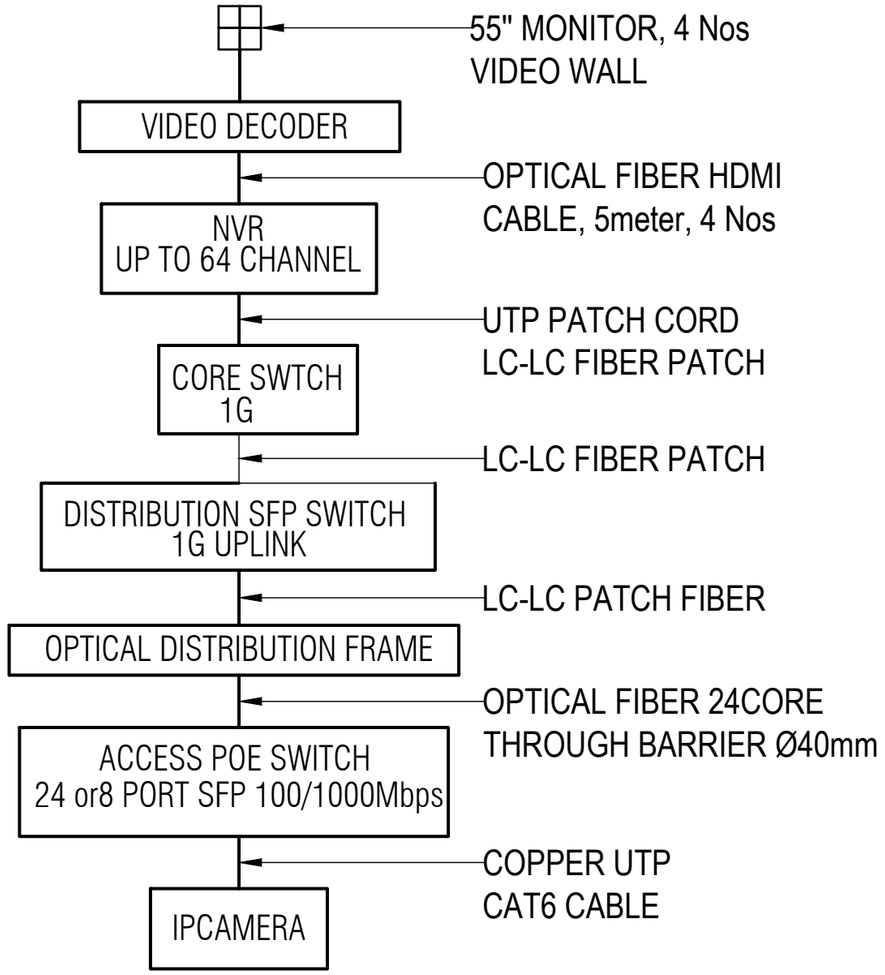
Electric Pit Top View

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Schematic Diagram of Typical Distribution Board for High Mast Pole and Distribution board of Open Repair Facility CAD BY: / SCALE: AS SHOWN
			Revision History: 1. / 2. / 3. Date: 30-Apr-2025 Status: Revision: Drg No. D-11-C-009

TENDER DRAWINGS



Single Line Diagram,
Open Yard Network Switch



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Schematic Diagram of Typical Distribution Board for High Mast Pole and Distribution board of Open Repair Facility CAD BY: / SCALE: AS SHOWN	Revision History: 1. / 2. / 3. Date: 30-Apr-2025 Status: Revision: Drg No. D-11-C-010

Equipment Description	
Sl No.	Description
01	Anti-vortex Plate
02	OS & Y Gate Valve with Temper/ Supervisory Switch
03	Y-Strainer
04	Flexible Joint
05	Eccentric Reducer
06	Pressure Gauge with ball Valve
07	Electric Motor Driven Pump
08	Concentric Reducer
09	Non-return Valve
10	OS & Y Gate Valve
11	Water Flow Meter
12	Globe Valve with Cap
13	Tee with Plug
14	Orifice Clapper Valve
15	Electric Pump Control Panel
16	Electric Motor Driven Jockey Pump
17	Jockey Pump Control Panel
18	Diesel Engine Driven Pump
19	Diesel Engine Pump Control Panel
20	Pressure Relief Valve
21	Waste Cone
22	Fuel Storage Tank with Accessories
23	Automatic Air Release Valve
24	Flow Switch

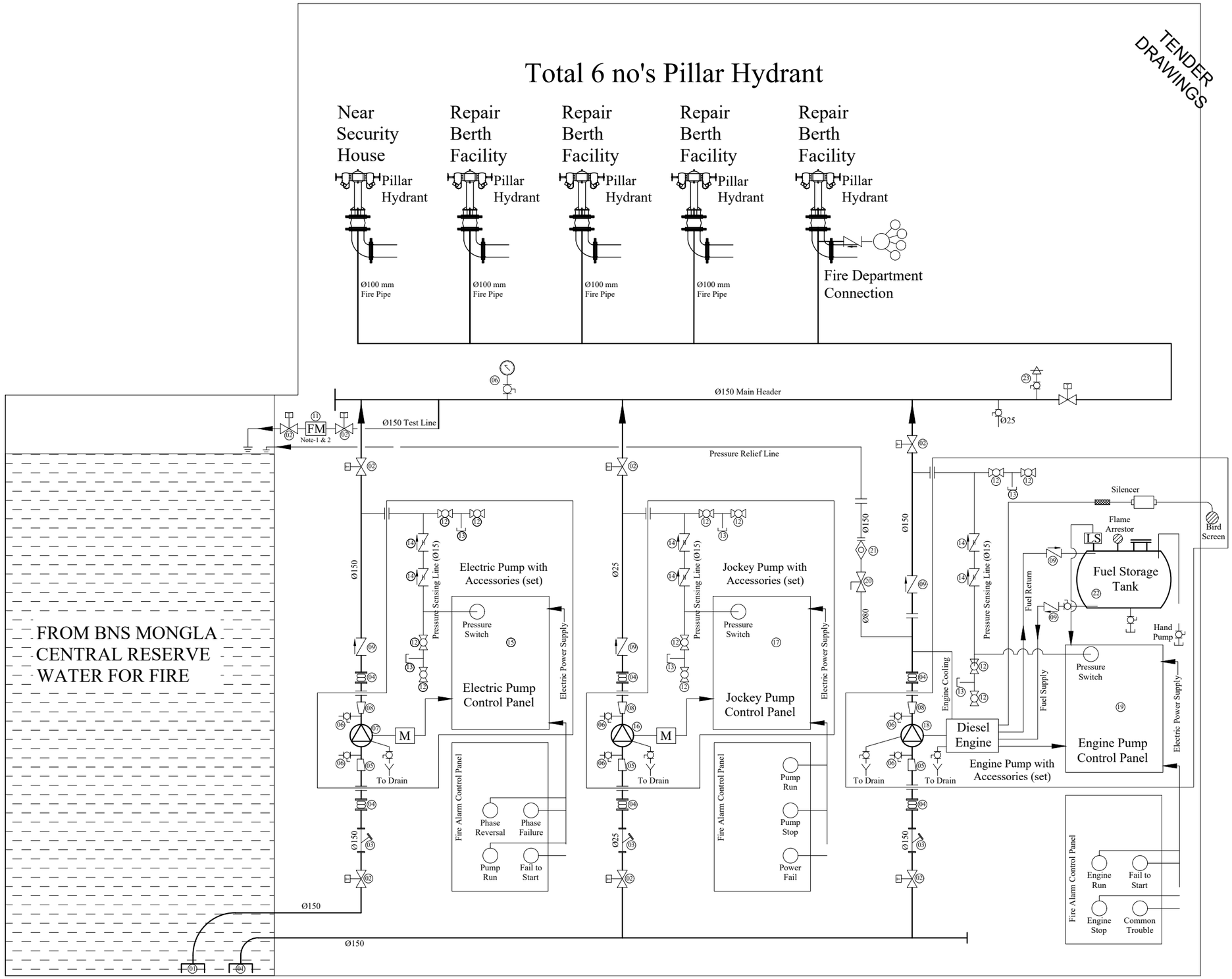
Notes:
1. Metering Device shall be Capable of Water flow not less than 175% of Rated Pump Capacity.

2. The installation of Pumps shall be fabricated, installed, tested and placed according to NFPA-20

Sequence of Operation for Fire Pumps and Jockey Pump:

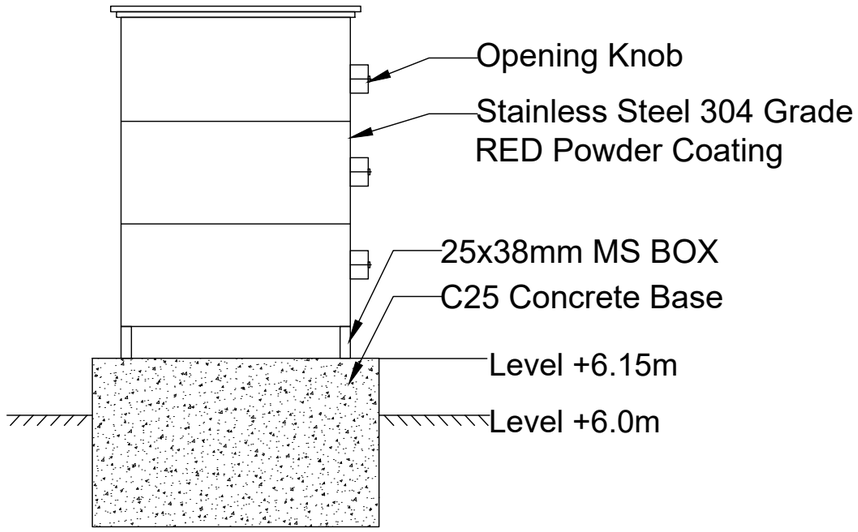
Pumps	Rated Flow & Pressure
Electric Motor Driven Jockey Pump (Make-up Pump)	25 GPM & 159.5 psi
Electric Motor Driven Fire Pump (Duty Pump)	500 GPM & 159.5 psi
Diesel Engine Driven Fire Pump (Standby Pump)	500 GPM & 159.5 psi

TENDER DRAWINGS

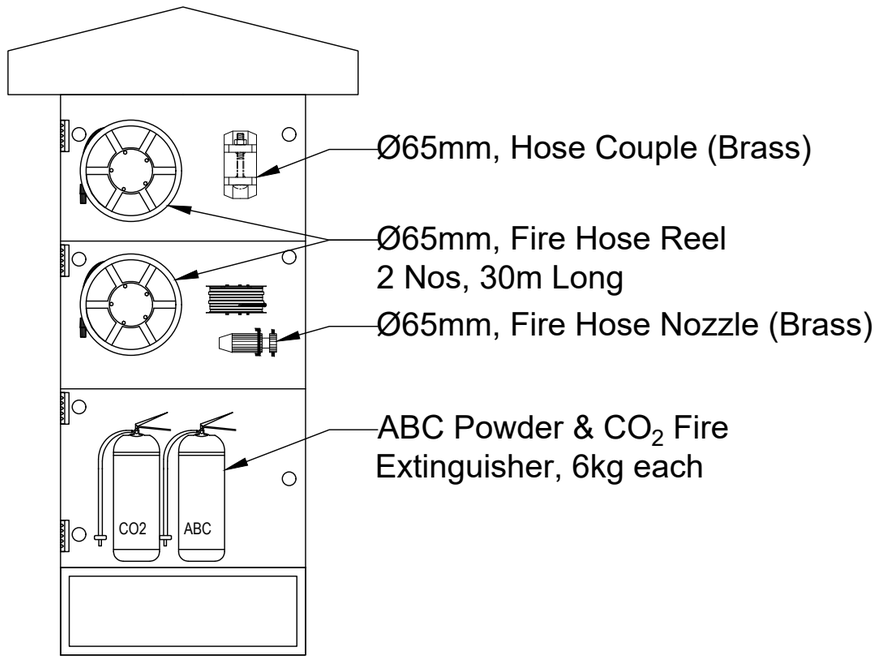


PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Schematic Diagram of Typical Distribution Board for High Mast Pole and Distribution board of Open Repair Facility CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: Drg No. D-11-C-011

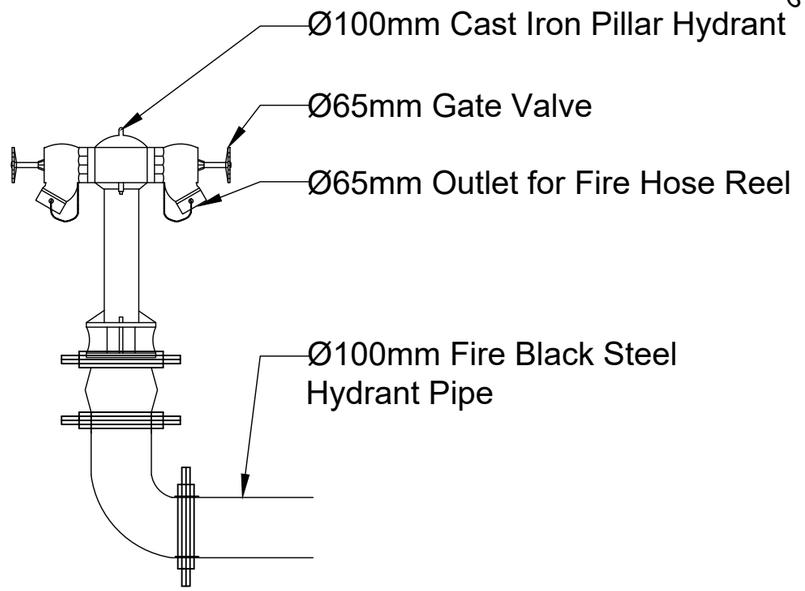
TENDER DRAWINGS



Fire Hose Cabinet (FHC)

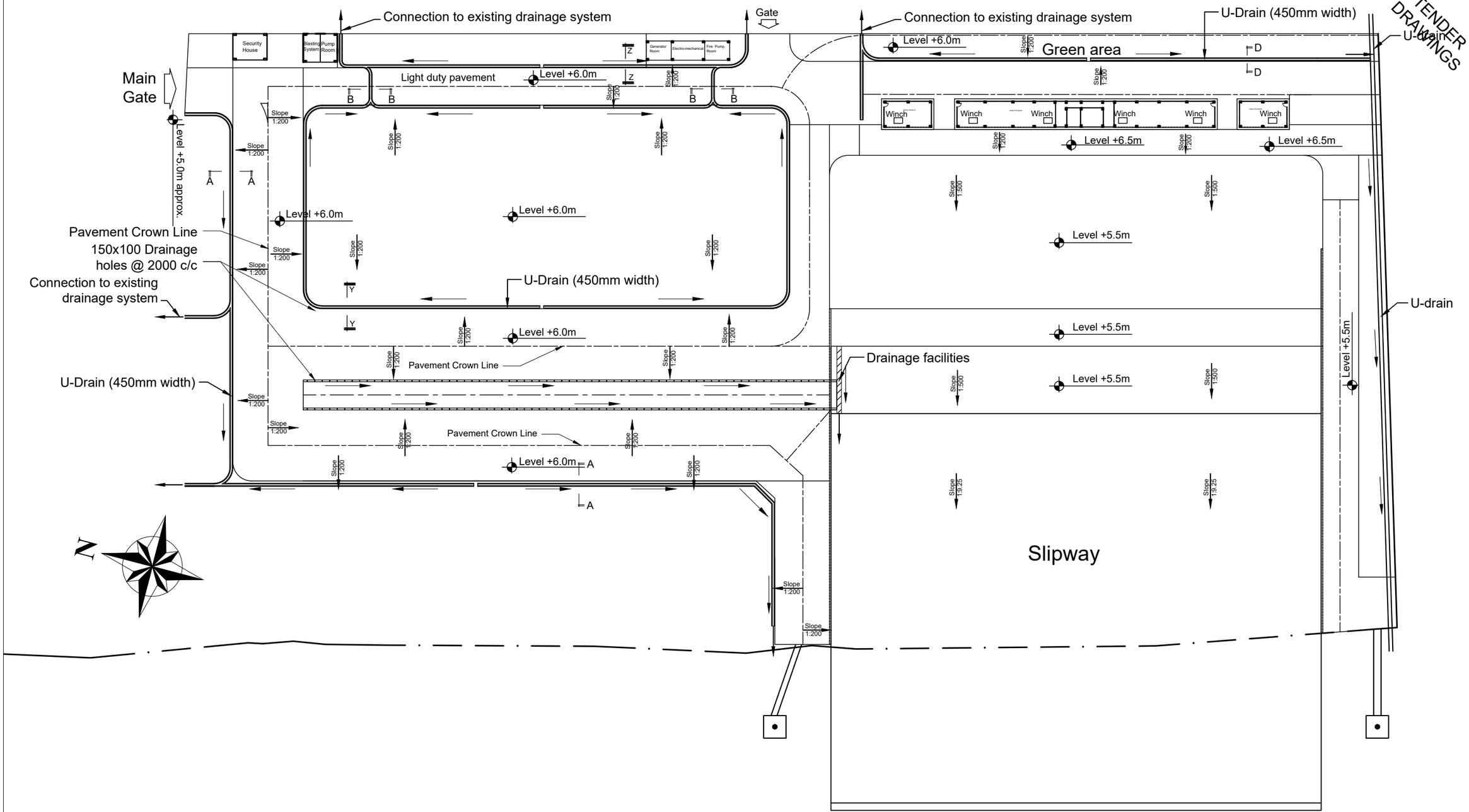


Fire Hose Cabinet (FHC)



Type: 100mm BS standard pillar fire hydrant
Valve Type: Two way, BS standard, 100mm
Body material : Cast Iron body,brass hydrant valves
Working pressure : 1.6Mpa(16 bar)
Inlet : 4" Table T BS 10 Flange
Outlet : Copper Alloy 2x2.5" Control Valve with
Female BS Inst. Outlet
Adaptor: Brass /LG2(Gun Metal)
Paint Finish : Red & Yellow Epoxy Coated

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical and CCTV Design of Pavement SHEET TITLE: Schematic Diagram of Typical Distribution Board for High Mast Pole and Distribution board of Open Repair Facility CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-C-012	Date: 30-Apr-2025 Status: Revision:

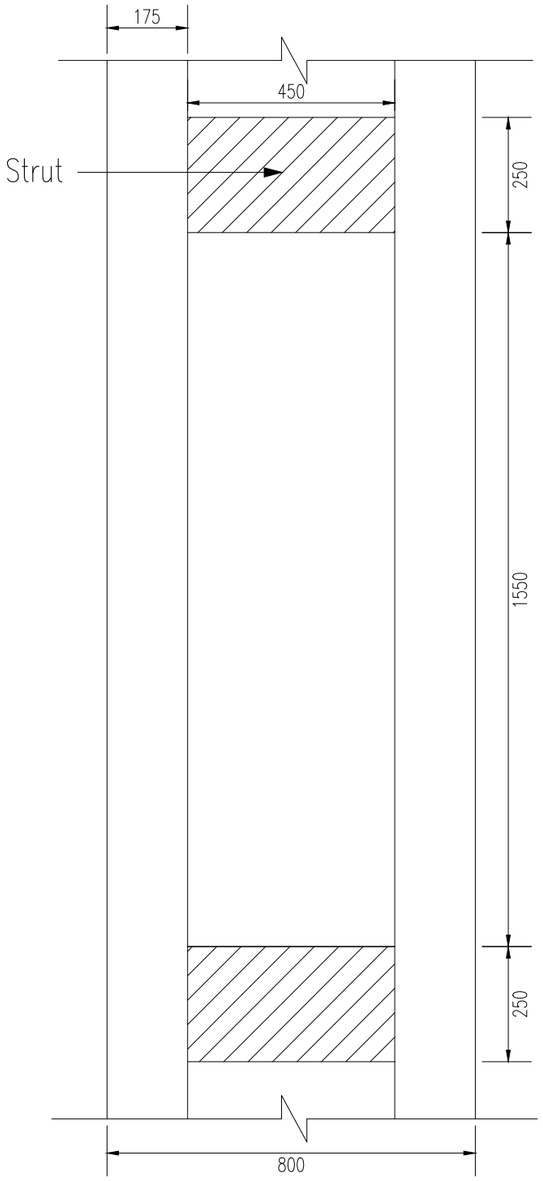


Note:

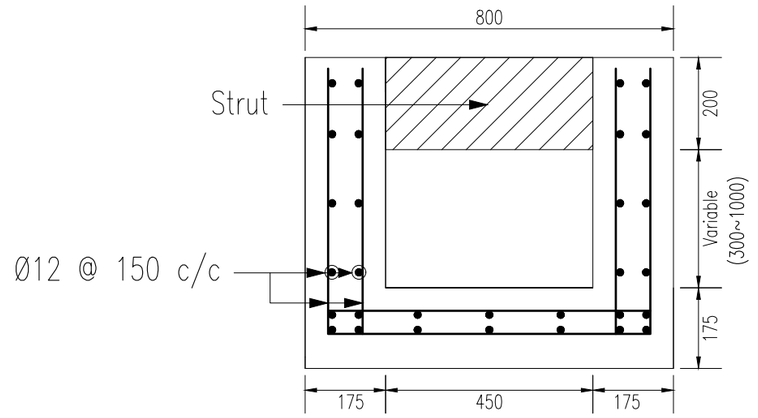
a. All dimensions are in meter unless otherwise shown.
b. All levels are in Chart Datum

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DRAINAGE DETAILS	Revision History:
			SHEET TITLE: Layout of rainwater drainage	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-11-D-001

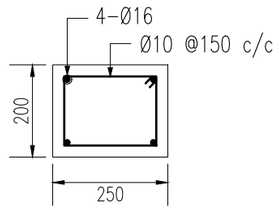
TENDER DRAWINGS



Plan View of U-Drain



Cross-Section of U-Drain on Edges of Pavement (Section A-A)



Details of Strut

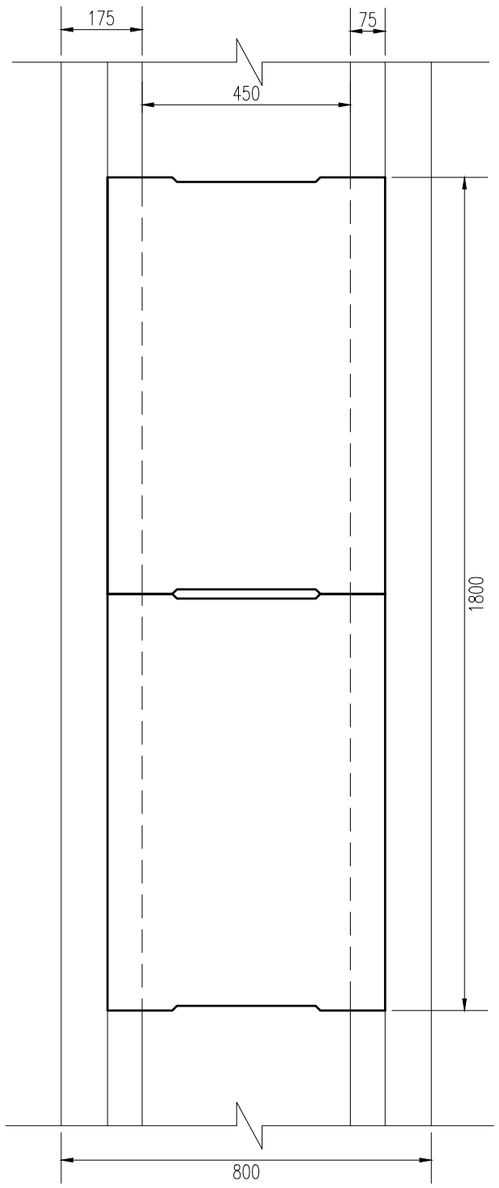
Details of U-Drain Sec. A-A

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DRAINAGE DETAILS SHEET TITLE: Typical U-Drain system without slab cover CAD BY: SCALE: AS SHOWN

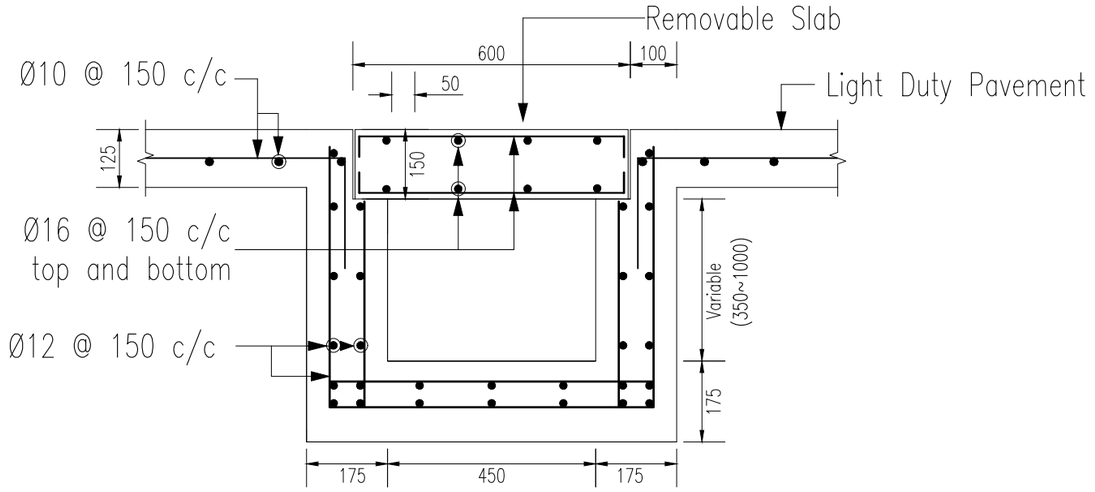
Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00

Drg No. D-11-D-002

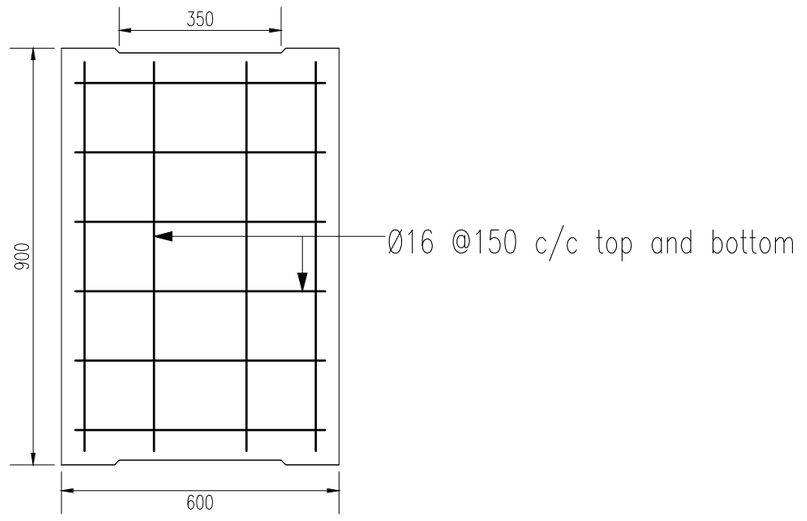
TENDER DRAWINGS



Plan View of U-Drain



Cross-Section of U-Drain (Section B-B)

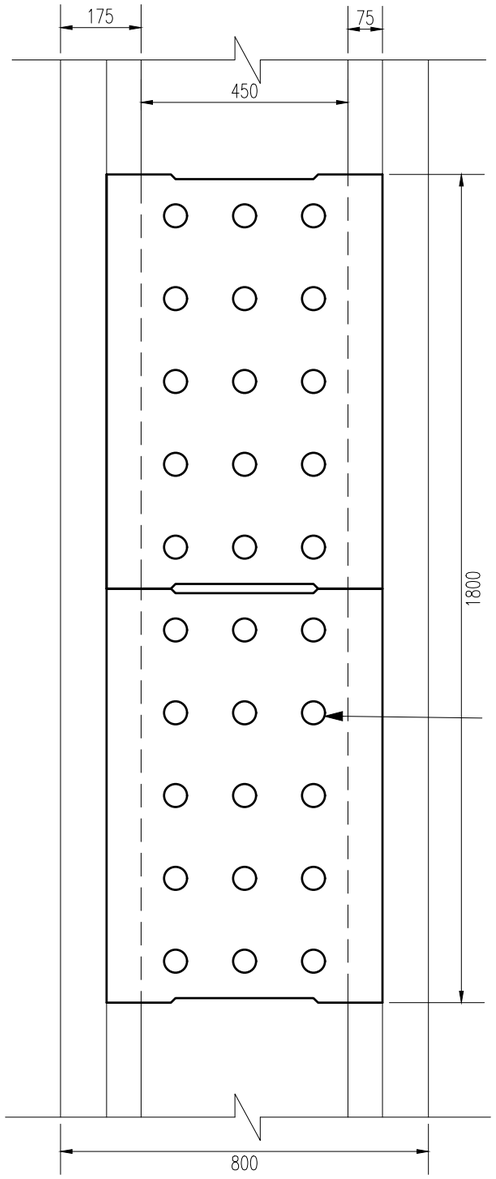


Details of U-Drain Slab

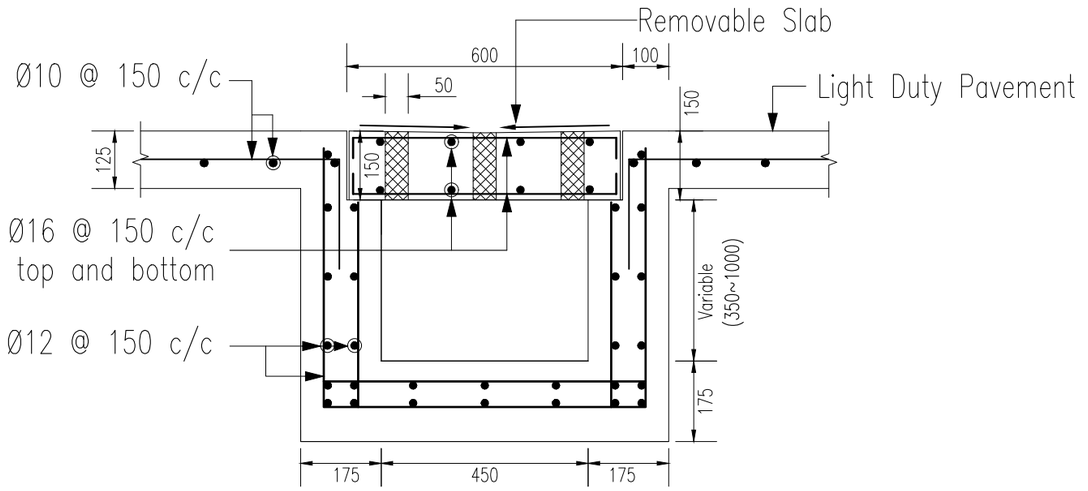
Details of U-Drain across the Light Duty Pavement
Sec. B-B

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DRAINAGE DETAILS SHEET TITLE: U-Drain details with slab cover across the light duty pavement CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-11-D-003	Date: 30-Apr-2025 Status: Revision: R-00

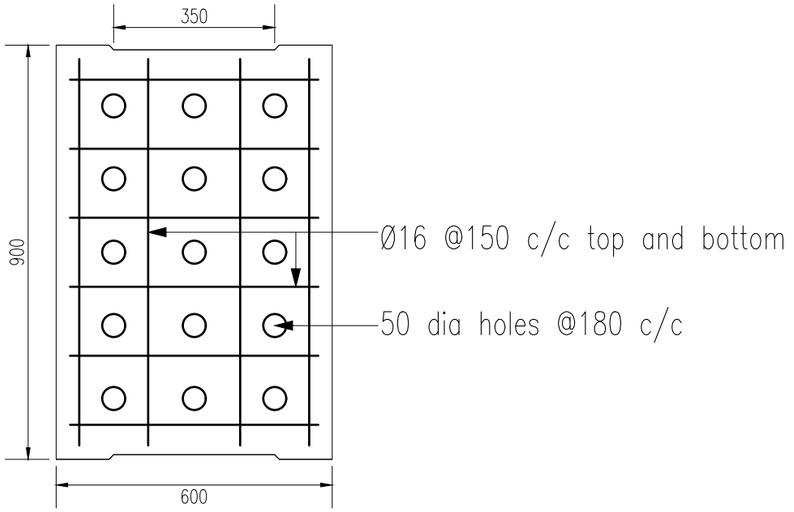
TENDER DRAWINGS



Plan View of U-Drain



Cross-Section of U-Drain (Section D-D)



Details of U-Drain Slab

Details of U-Drain through the Light Duty Pavement near the Winch Control and Power Supply Sec. D-D

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: PAVEMENT DRAINAGE DETAILS	Revision History:
			SHEET TITLE: Slab cover U-Drain details with rainwater passing holes	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-11-D-004

TENDER DRAWINGS

BANGLADESH NAVY

PROJECT

ENGINEERING PROCUREMENT AND CONSTRUCTION
INCLUDING INSTALLATION OF
SHIP DOCKING AND REPAIR FACILITY
AT MONGLA

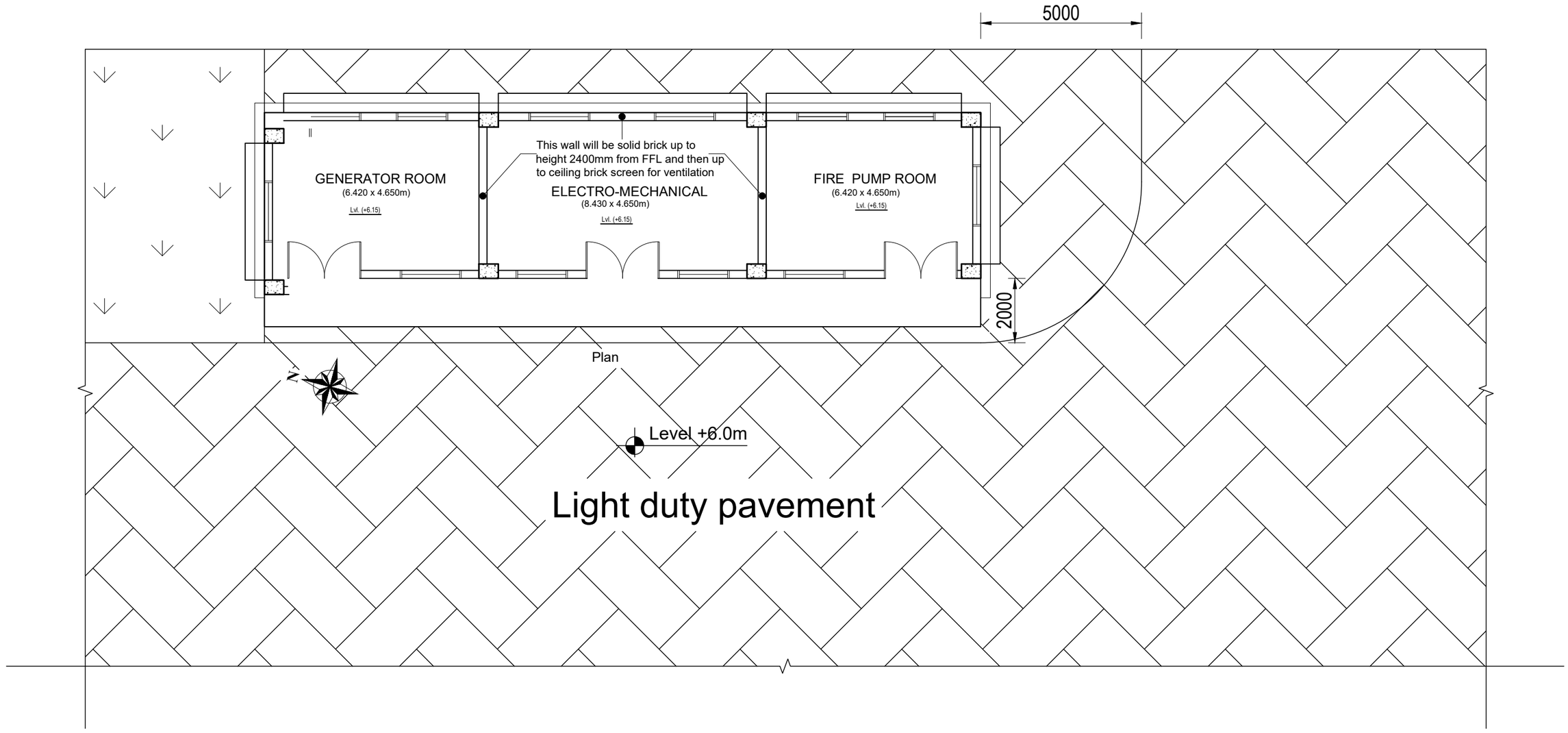
Generator, Electro-Mechanical and Fire Pump Room Design

CONSULTANT

BUREAU OF RESEARCH, TESTING AND CONSULTANT (BRTC)
BUET, DHAKA-1000
BANGLADESH

April 2025

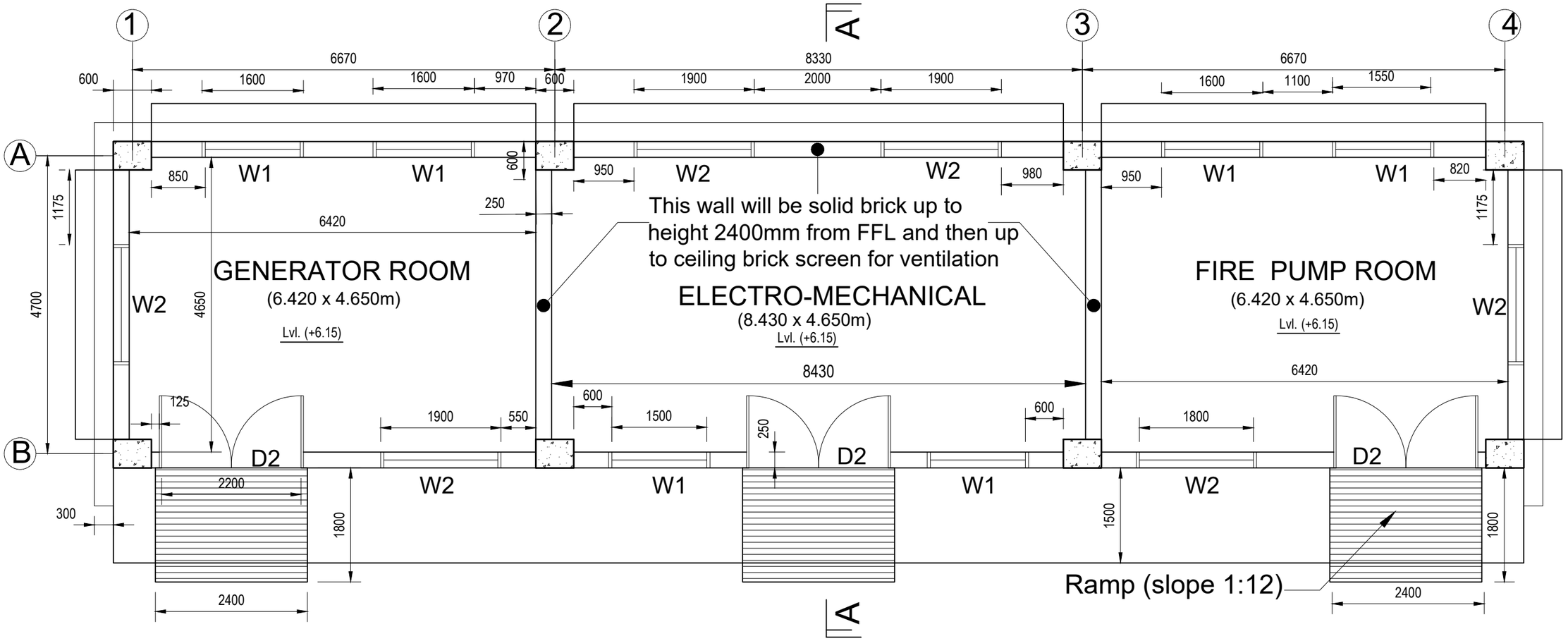
TENDER DRAWINGS



Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room	Revision History:	
			SHEET TITLE: Typical Layout Plan	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			SCALE: AS SHOWN	Drg No. D-12-A-001	

TENDER DRAWINGS

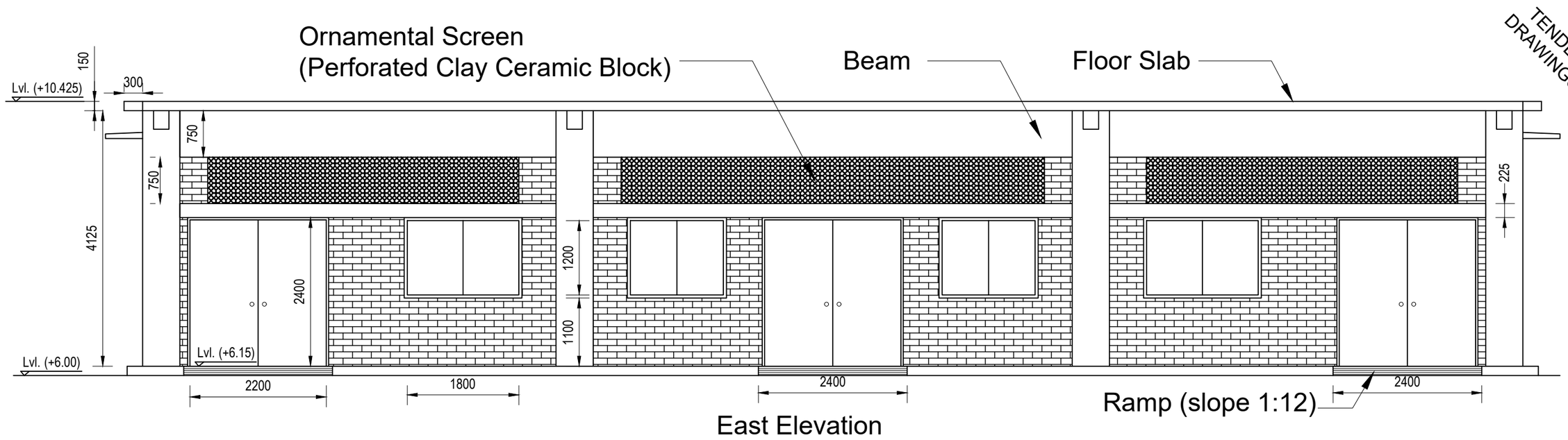


N

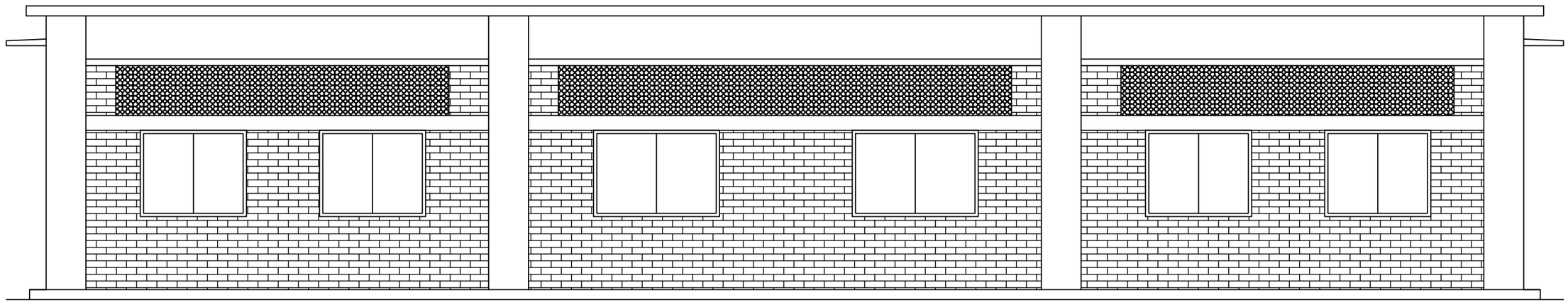
Floor Plan

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Floor Plan SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-A-002	 Date: 30-Apr-2025 Status: Revision: R-00

TENDER DRAWINGS



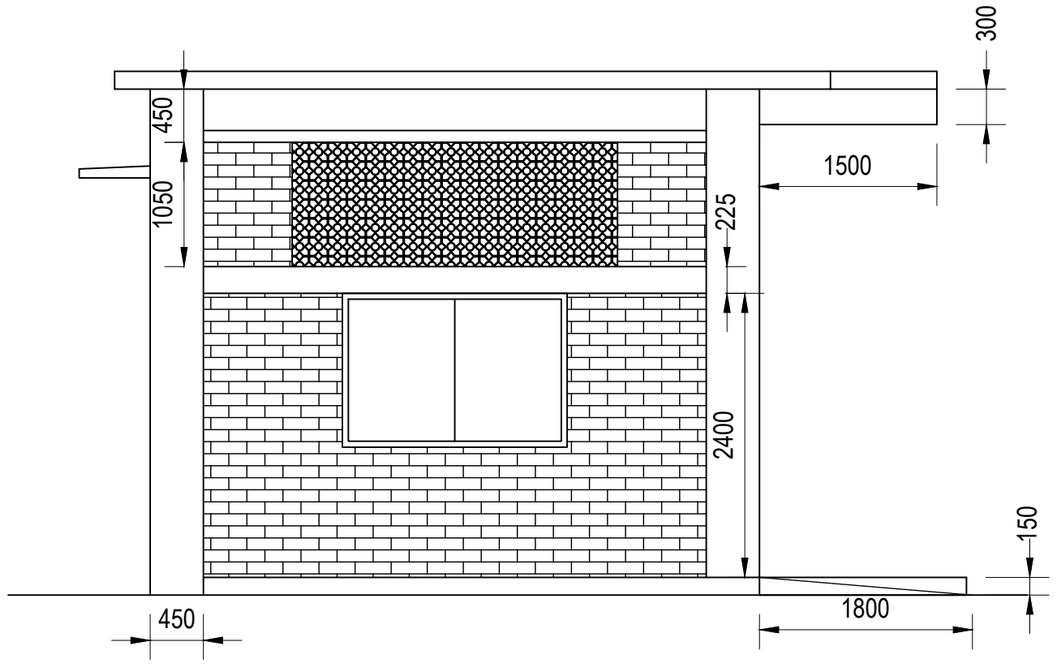
East Elevation



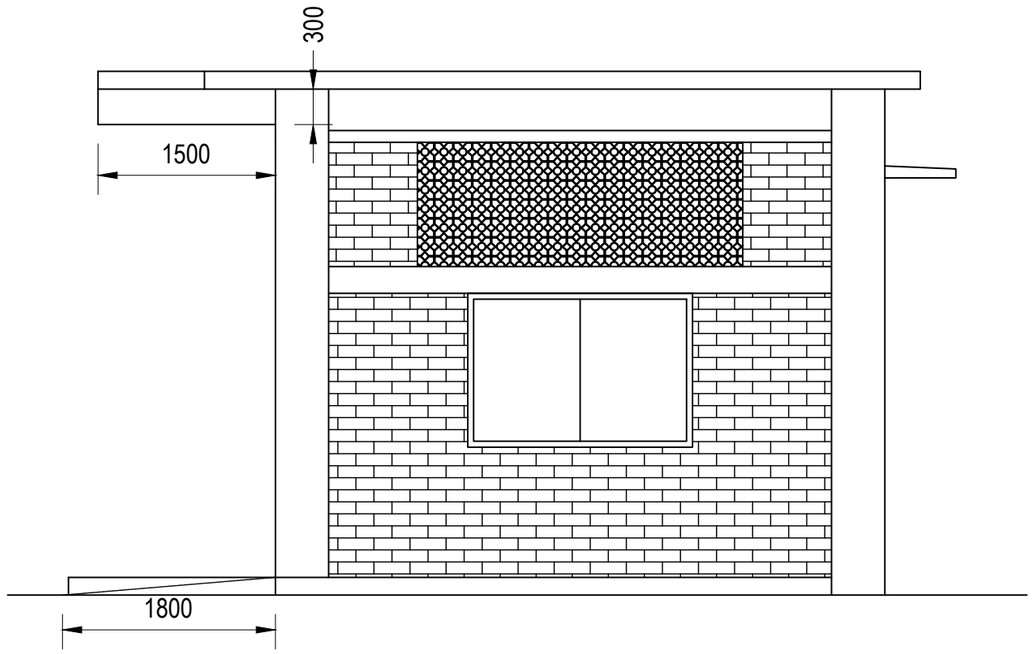
West Elevation

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Elevation Drawings SCALE: AS SHOWN	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-12-A-003

TENDER DRAWINGS



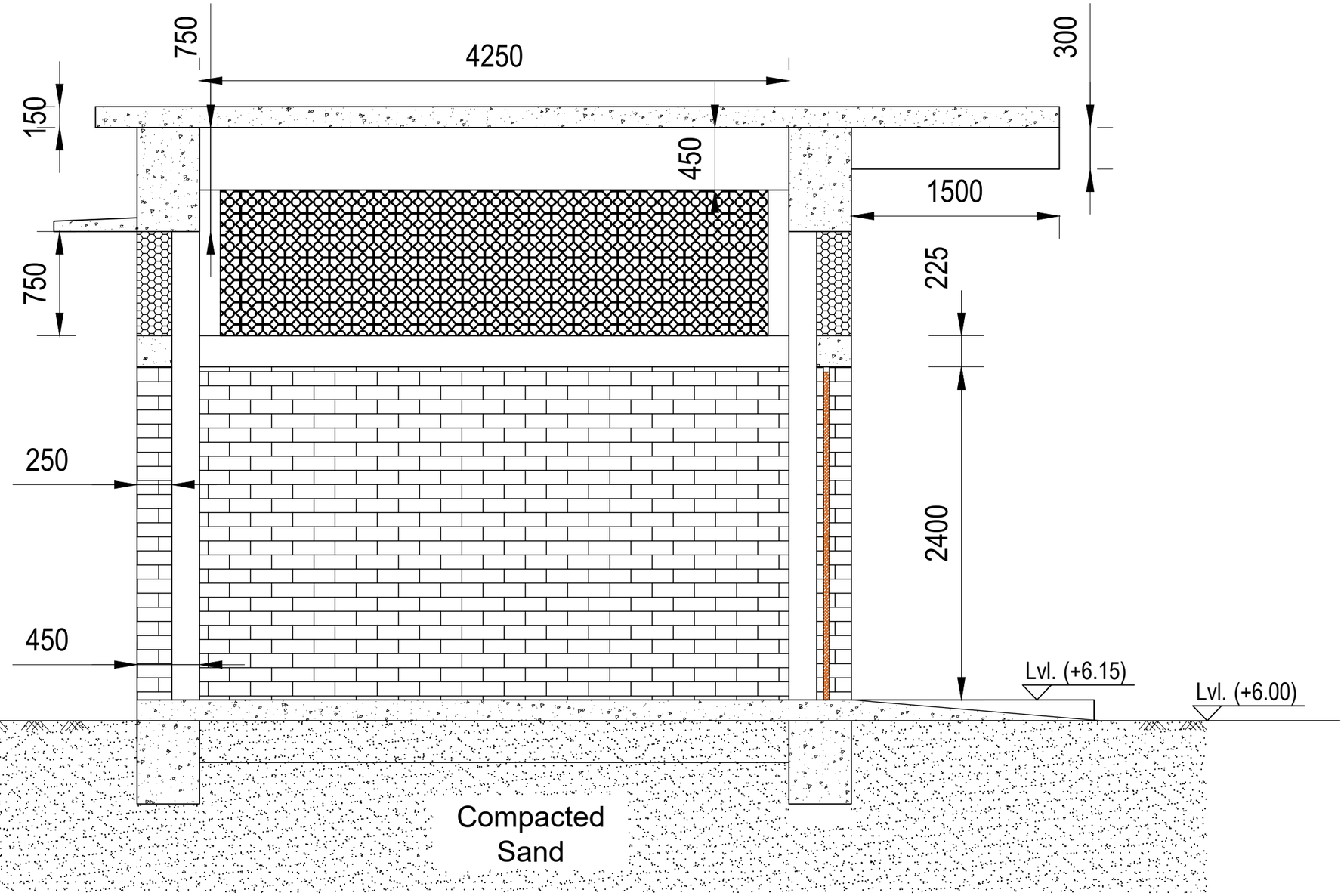
North Elevation



South Elevation

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Elevation Drawings SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-A-004 Date: 30-Apr-2025 Status: Revision:

TENDER DRAWINGS



Section A-A

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room	Revision History:	
			SHEET TITLE: Section Drawing	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision:
			SCALE: AS SHOWN	Drg No. D-12-A-005	

TENDER DRAWINGS

WINDOW SCHEDULE		
TYPE	DESCRIPTION	SIZE (mm)
W1	Glass Panel with Aluminium Frame Sliding Window	1600 X 1300
W2	Glass Panel with Aluminium Frame Sliding Window	1900 X 1300

DOOR SCHEDULE		
TYPE	DESCRIPTION	SIZE (mm)
D1	Double Panel Wooden Door	2275 X 2400

PROJECT
ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA

OWNER
BANGLADESH NAVY

CONSULTANT
Bureau of Research, Testing and Consultation (BRTC)
BUET, Dhaka-1000, Bangladesh.

DRG. TITLE: Architectural Drawings of Generator, Electro-Mechanical and Fire Pump Room

SHEET TITLE: Window and Door Schedule

SCALE: AS SHOWN

Revision History:

1.		Date: 30-Apr-2025
2.		Status:
3.		Revision:

Drg No. D-12-A-006

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

1. STRUCTURAL DESIGN NOTES

a. Structural detailing shall follow ACI DETAILING MANUAL SP-66(20) unless otherwise shown.
b. All structural drawings shall be read in conjunction with relevant architectural drawings.

2. GENERAL INSTRUCTIONS

a. Please do not scale from the drawings.
b. All dimensions on these drawings shall be checked on site before the work commences. Figured dimensions shall be taken in preferences to scaled dimensions. Project engineer, site engineer, contractors and sub-contractors shall notify the consultant/owner about any discrepancies/differences observed in the drawings before commencing the work.
c. Project engineer, site engineer, contractors and sub-contractors are to verify the followings at site: i) Reinforcement position, ii) Development length, iii) Clear cover, iv) Concrete mix ratio, v) Levels.

3. MEMBER SIZES AND DIMENSIONS

Unless otherwise noted elsewhere, the size and dimensions of structural members shown on the drawings are net or minimum dimensions that satisfy the structural design and safety requirements. These dimensions may not be reduced due to incorporation of architectural features such as ornamental works, grooves etc. If any such architectural feature is to be included, such inclusion must be outside/beyond the dimensions shown on the drawings and such addition must be approved by the designer/engineer of the project.

4. MATERIALS

a. Coarse aggregate:
Crushed natural stone chips. Aggregate grading shall meet the requirements of ASTM C33/C33M-13 specification. Los Angeles Abrasion value shall not exceed 25% (for Grading B).
TESTS: i) Sieve analysis, ASTM C136-14 ii) L.A. Abrasion Test ASTM C131-14.
Maximum aggregate size for all concreting works except the wearing course shall be 20mm. Maximum aggregate size for the wearing course shall be 12mm.

b. Fine aggregate:
i) Sylhet sand of F.M.≥2.5 shall be used for all structural components e.g. footing, pile, pile caps, column, deck slabs, floor slabs, grade slabs, parapets, beam, slab, stair, water tank etc.
ii) Local sand of F.M.≥1.0 shall be used for non-structural components e.g. plastering, floor finish etc.
iii) Local sand of F.M.≥0.6 shall be used for earth filling works.
Aggregate grading for structural components shall meet the requirements of ASTM C33/C33M-13 specification.
TESTS: i) Sieve analysis, ASTM C136-14

c. Cement:
As per standards BDS EN 197-1:2003, Type CEM-II or CEM-III, Strength Class 42.5N
TESTS: i) Setting time and soundness by EN 196-3, ii) Strength by EN 196-1, iii) Fineness by EN 196-6.

d. Steel Reinforcement:
Unless stated otherwise elsewhere, all reinforcing bar shall conform to standard BDS ISO 6935-2:2021, Grade B500DWR.
TESTS: i) Unit weight, yield strength, ultimate strength and elongation by ISO-6892-1-2009, ii) Bend test by ISO-7438-2005, iii) Surface deformation measurement.

e. Water:
Clean water free from impurities (e.g. salinity, hardness, chlorine/chloride, sulphate) shall be used for concreting. Amount of water shall be in accordance with concrete mix design.

5. CONCRETE

a. Concrete mix proportion shall be determined based on appropriate mix design to achieve the required average compressive strength (f'_{cr}) following the guideline of BNBC 2020 section 5.6.2, Part 6.

b. To achieve workability, superplasticizer RHEOBUILD 1100 (BASF) or equivalent may be used. The dose and procedure of adding superplasticizer shall be as per the manufacturer's specifications.

c. Curing of concrete:
Minimum curing time shall be 28 days. Method of curing shall be; i) Slabs: ponding, ii) Columns/walls: wraping hessian and wetting it periodically, iii) Beams: periodically spraying water from underside.

d. Concrete strength:
Concrete grade (design strength, f'_c, in MPa) and corresponding required average compressive strength, f'_{cr}, (as defined in BNBC 2020, Sec 5.6.2.2 of Part VI) for various components are as follows:

Structural element	Design strength, f'_c	Req. avg. comp. str, f'_{cr},
Precast Driven Pile	Grade 40	50 MPa
Pile cap and substructure	Grade 35	45 MPa
Reinforced concrete superstructure	Grade 35	45 MPa
Lean concrete in foundation bed	Grade 20	30 MPa

Achievement of the required average compressive strength shall be confirmed by preparing and testing cylinder samples in accordance with ASTM C31 and ASTM C39.

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			SHEET TITLE: General Notes for Reinforced Concrete Items - 1 of 5	1. Date: 30-Apr-2025 2. Status: 3. Revision: R-00
			CAD BY: / SCALE: AS SHOWN	Drg No. D-12-B-001

TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

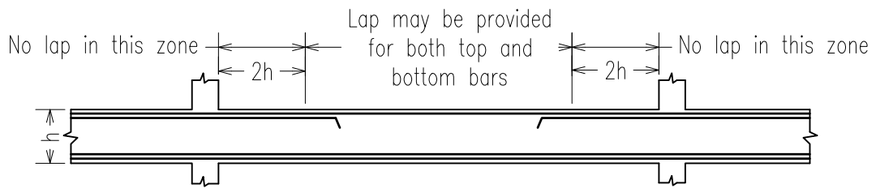
Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

6. MINIMUM LAP LENGTH FOR REINFORCING BARS (mm)

fc' = 35 MPa, fy = 500 MPa			
Class-B Lap Splice Length for Deformed MS Rebar (rounded to nearest 25mm)			
Bar dia.	Top bars in beam and mat; top bars in slab of thickness more than 300mm	Bottom bars in slab, beam and mat; top bar in slab of thickness less than 300mm	Vertical compression rebar in column and shear wall
mm	mm	mm	mm
10	750	575	425
12	900	700	500
16	1200	925	650
20	1500	1150	825
25	2350	1800	1025

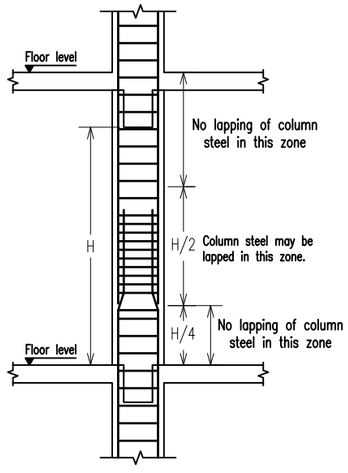
Notes: 1) 22mm dia. bars are not recommended, 2) Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of length shall be needed, 3) ACI Type–2 mechanical couplers are recommended for 25mm dia. bars but mandatory for bar dia. more than 25mm.

7. LAP SPLICE LOCATION IN BEAMS



Not more than 50% of the bars shall be spliced at one place of the beam. Lap splices are to be confined by hoops/stirrups with maximum spacing of 100mm.

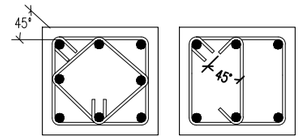
8. LAP SPLICE LOCATION IN COLUMNS



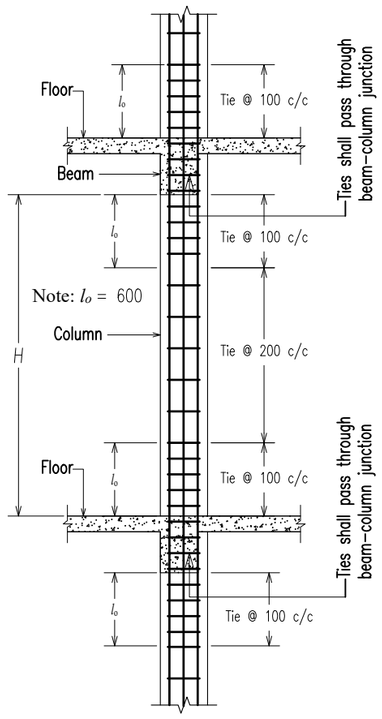
Lap splices are to be confined by hoops/ties with maximum spacing of 125mm.

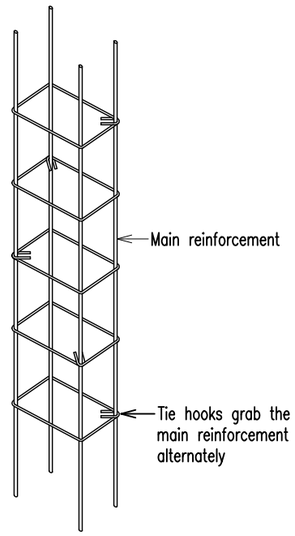
9. COLUMN TIE DETAILS

a. Hook's of column ties:
Hooks of column ties shall be bent 45° inwards and length of the hook shall be minimum 75mm as shown below. Ties shall be arranged such that corner hooks grab the main reinforcement in alternate fashion. Tie spacing shall be in accordance with that shown in fig below.



b. Spacing of column ties in buildings:
Spacing of column ties shall be as shown in fig below.





Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room	Revision History:	
			SHEET TITLE: General Notes for Reinforced Concrete Items - 2 of 5	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-12-B-002

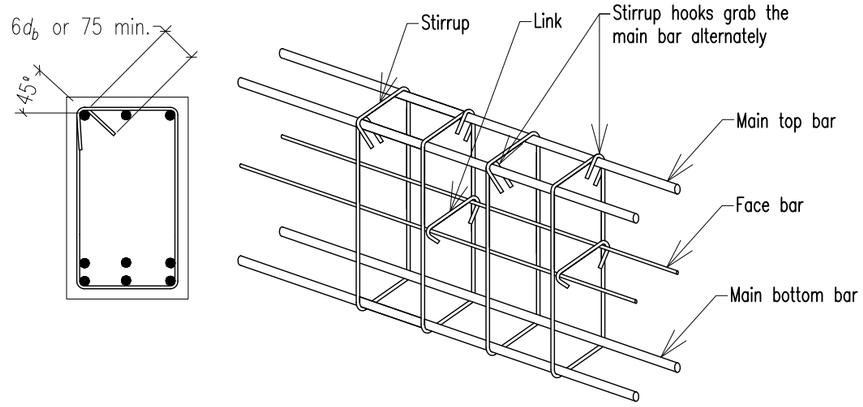
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

10. BEAM STIRRUP

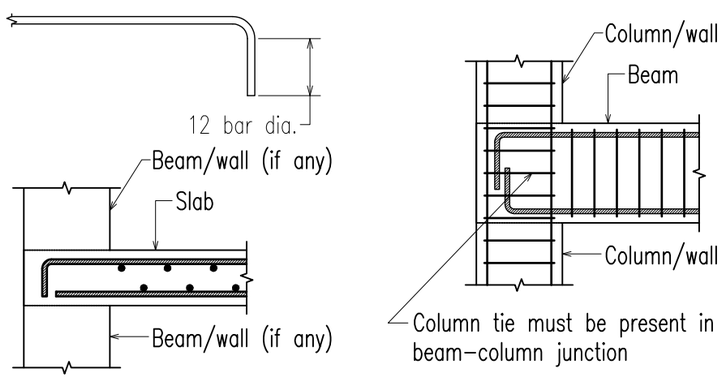
Hooks in beam stirrups shall be bent 45° inwards and length of the hook shall be minimum 3" (75mm) as shown below. Stirrups shall be arranged such that corner hooks grab the main reinforcement in alternate fashion.



11. END ANCHORAGE FOR HORIZONTAL REINFORCEMENT (IN BEAM, SLAB, MAT ETC).

90° hooks shall be provided for i) all main bars of beams (top and bottom) which terminate into column or walls or other beams. ii) slab top bars terminating into supporting beams or walls. iii) mat reinforcement terminating at the periphery.

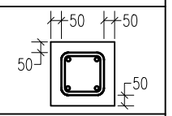
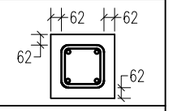
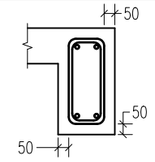
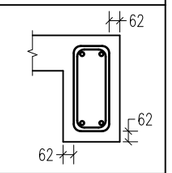
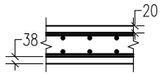
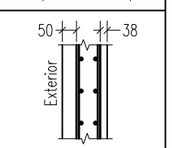
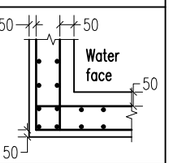
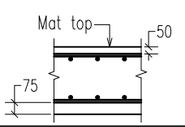
For all cases, the length of the hook shall be 12 times the bar diameter ($12d_b$).



Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

12. MINIMUM CLEAR COVER FOR REINFORCING BARS

Minimum concrete cover for reinforcing bars shall be as shown in the following table. In all cases the cover is measured from the concrete surface to the nearest reinforcement surface e.g. surface of ties in column, stirrups in beams etc.

Member	Condition	Thickness of Cover	Figure
Column, lift core and shear wall	Above ground level	50mm	
	Below or in contact with ground	62mm	
Beam	Top, side & bottom	50mm	
	Water face inside water tank side & bottom, below or in contact with ground	62mm	
Slab and stair	Top and bottom	20mm and 38mm	
R.C.C wall below ground	Exterior	50mm	
	Interior	38mm	
Water tank	Water face	50mm	
	Other face	50mm	
Footing and Mat foundation	Top	50mm	
	Bottom	75mm	

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: General Notes for Reinforced Concrete Items - 3 of 5 CAD BY: / SCALE: AS SHOWN
			Revision History: 1. / 2. / 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-12-B-003

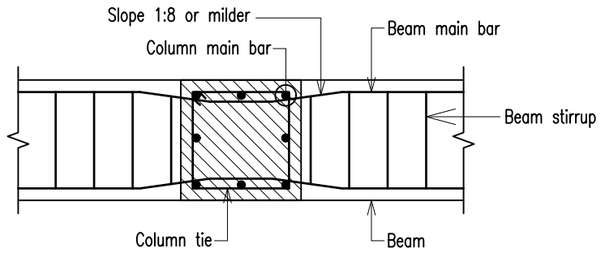
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

13. AVOIDING CONFLICT BETWEEN BEAM AND COLUMN REINFORCEMENT

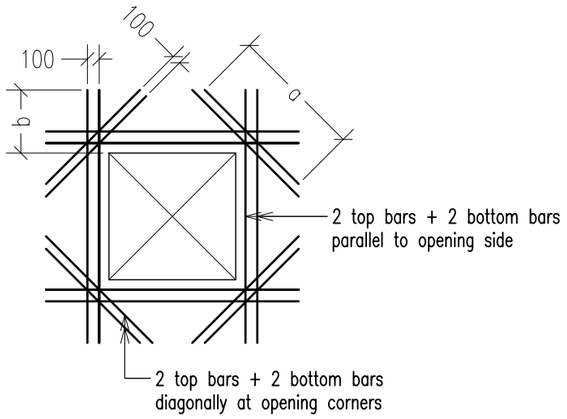
If conflict arises between beam and column or wall reinforcement when beam steel enters or passes through column, the beam reinforcement may be horizontally bent inwards into the column as shown in the following figure.



PLAN SECTION OF BEAM COLUMN JOINT

14. REINFORCEMENT DETAILING AROUND VOID/OPENING

Reinforcement details around void/opening in floor slabs shall be as shown in figure below. The detailing is valid for maximum void size of 900x900. For void/opening of larger size contact the consultant.

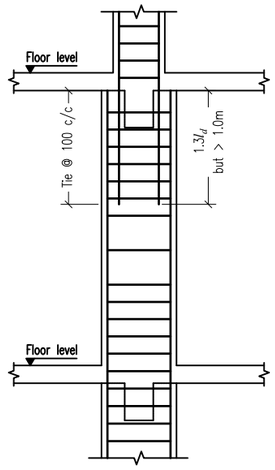


	Void/opening size less than 450	Void/opening size between 450 ~ 900
Dim. a	900	1500
Dim. b	600	900
Bar size	ø16	ø20

Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

15. COLUMN OFFSET DETAIL

When column size is reduced the transition of column main reinforcement from lower floor to upper floor shall be detailed as shown below.

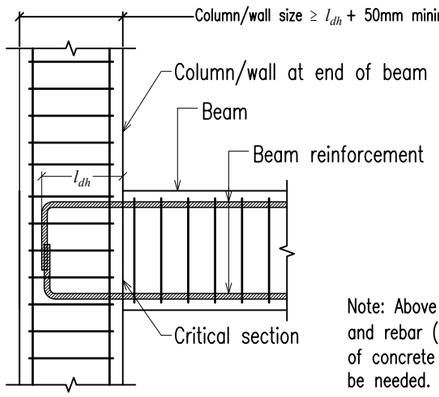


16. BRICK WORK

All brick work shall use first class brick or as specified by the consultant. Morter for brick work shall constitute 1:4 mix ratio (cement:sand). Morter for plastering work shall be 1:4 mix ratio (cement:sand).

17. END ANCHORAGE OF BEAM REINFORCEMENT

Minimum end anchorage length l_{dh} as shown below for different bar sizes must be maintained throughout.



fc' = 35 MPa, fy = 500 MPa	
Bar dia.	l_{dh}
mm	mm
10	150
12	150
16	225
20	300
25	425

Note: Above lengths are derived for the type of concrete (f'_c) and rebar (f_y) used specifically in this project. For other types of concrete and rebar, recalculation of embedment length shall be needed.

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			Revision History: 1. 2. 3. Drg No. D-12-B-004
			Date: 30-Apr-2025 Status: Revision: R-00

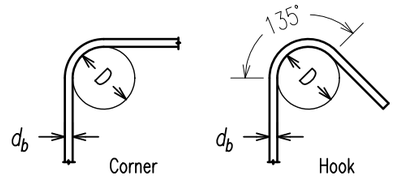
TENDER DRAWINGS

GENERAL NOTES FOR REINFORCED CONCRETE CONSTRUCTION

Note: Provisions of this general note shall be followed in construction unless more specific data/information is provided elsewhere on the drawings.

18. BAR BENDING PIN DIAMETER FOR HOOKS AND L-BENDS

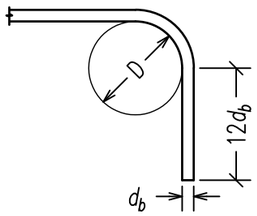
Stirrups of beams and ties of columns



D = inside bend diameter = $4d_b$
where d_b is the dia. of rebar.

Bar dia., d_b mm	Hook/Corner bend dia., D, mm
8	32
10	40
12	48
16	64

Main reinforcement

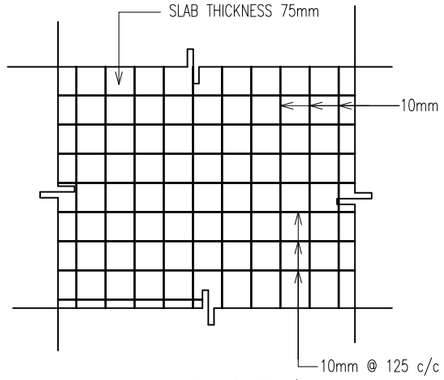


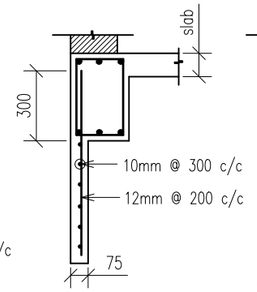
D = inside bend diameter = $6d_b$
where d_b is the dia. of rebar

Bar dia., d_b mm	Bend dia., D mm
10	60
12	72
16	96
20	120
22	132
25	150
32	256 ($8d_b$)

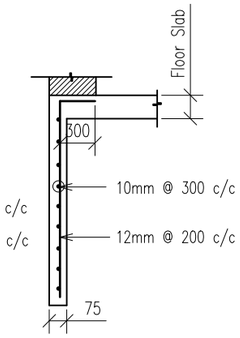
19. MISCELLANEOUS STRUCTURAL DETAILS

The miscellaneous details shown below shall be followed wherever applicable unless otherwise mentioned elsewhere.

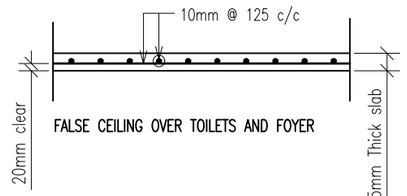




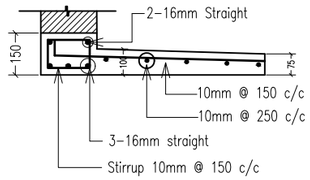
DROP PANEL: FROM BEAM



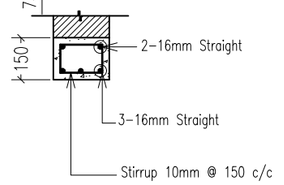
DROP PANEL: FROM SLAB



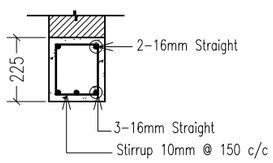
FALSE CEILING OVER TOILETS AND FOYER



WINDOW LINTEL WITH SUNSHADE



INTERIOR LINTEL (SPAN < 1.2m)

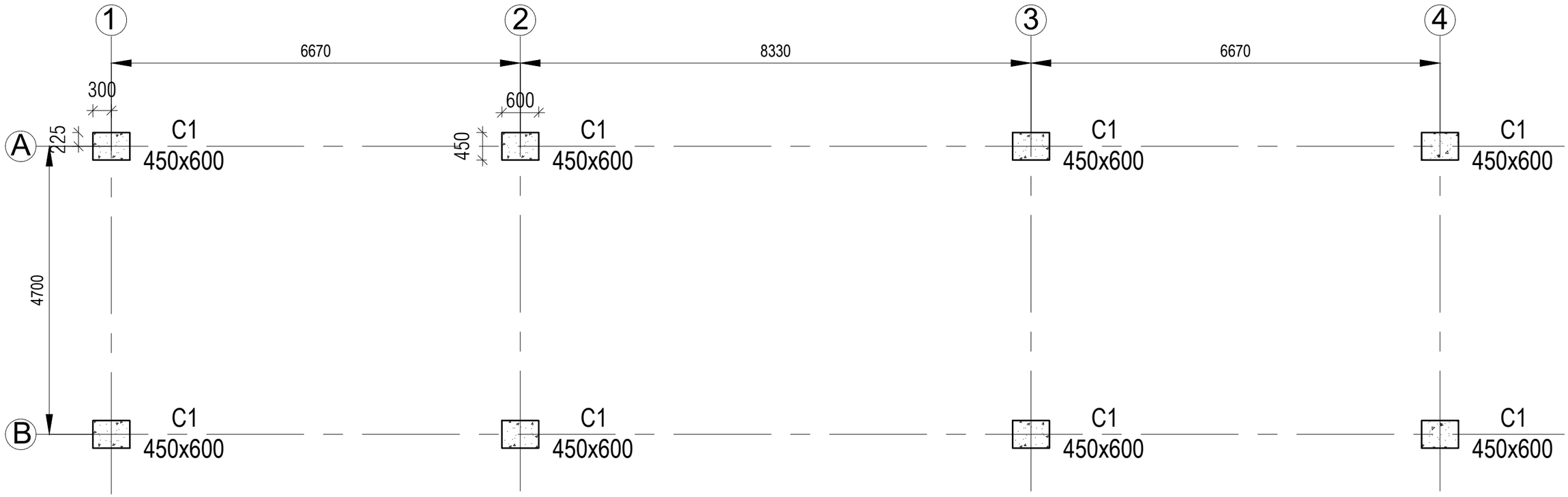


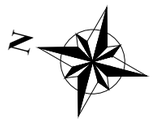
INTERIOR LINTEL (1.2m < SPAN < 2.4m)

Note: Structural detailing shown on this sheet shall be followed only if specific detail of a structural component is not shown elsewhere on other sheets.

PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room	Revision History:
			SHEET TITLE: General Notes for Reinforced Concrete Items - 5 of 5	1. Date: 30-Apr-2025
				2. Status:
				3. Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-12-B-005

TENDER DRAWINGS



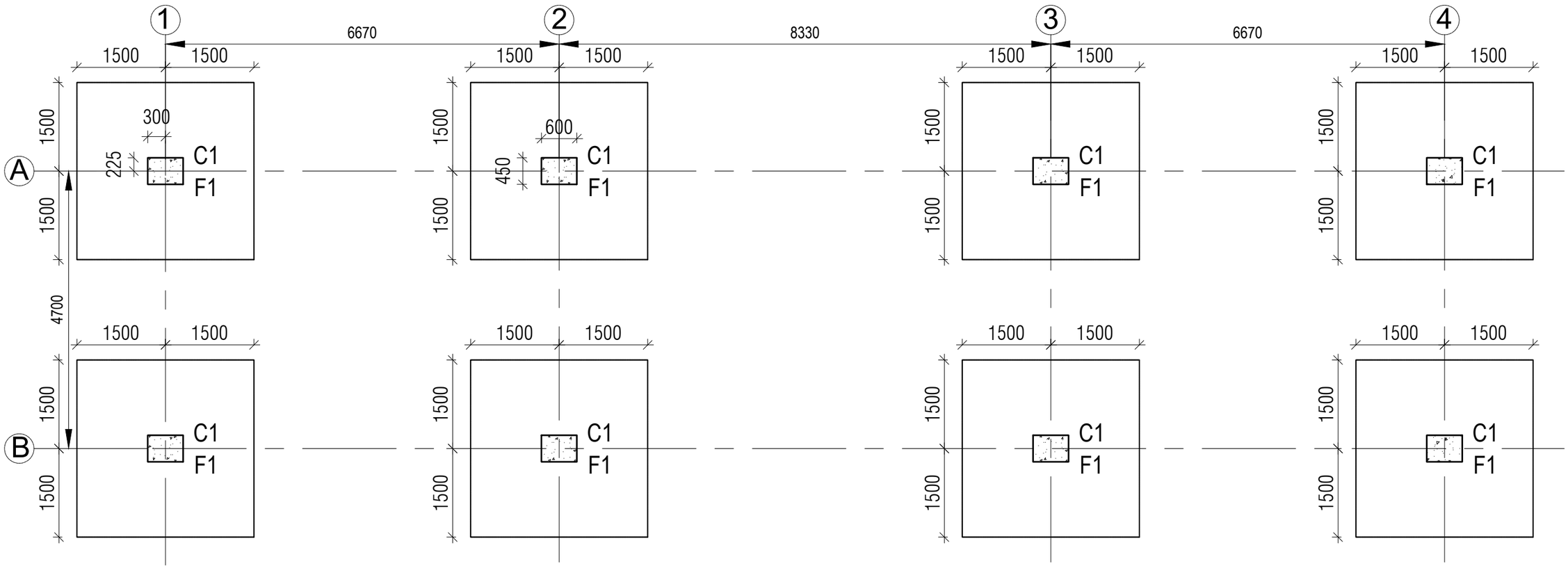


Column Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room	Revision History:	
			SHEET TITLE: Column Layout Plan of Generator, Electro-Mechanical and Fire Pump Room	1.	Date: 30-Apr-2025
				2.	Status:
				3.	Revision: R-00
			CAD BY: SCALE: AS SHOWN	Drg No. D-12-B-006	

TENDER DRAWINGS

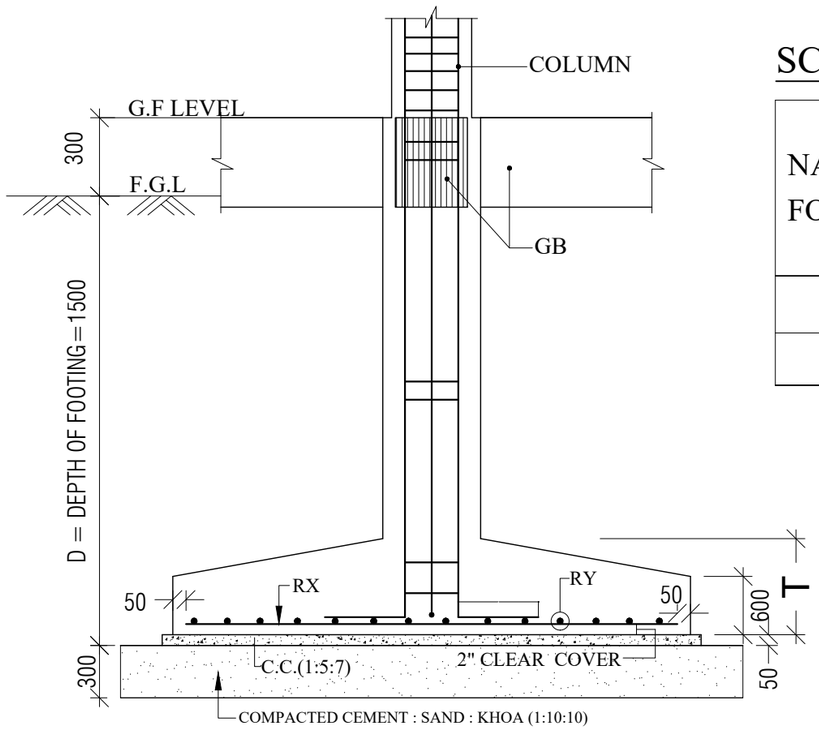


Footing Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room		Revision History:	
			SHEET TITLE: Footing Layout Plan of Generator, Electro-Mechanical and Fire Pump Room		1.	Date: 30-Apr-2025
					2.	Status:
					3.	Revision: R-00
			CAD BY:	SCALE: AS SHOWN	Drg No. D-12-B-007	

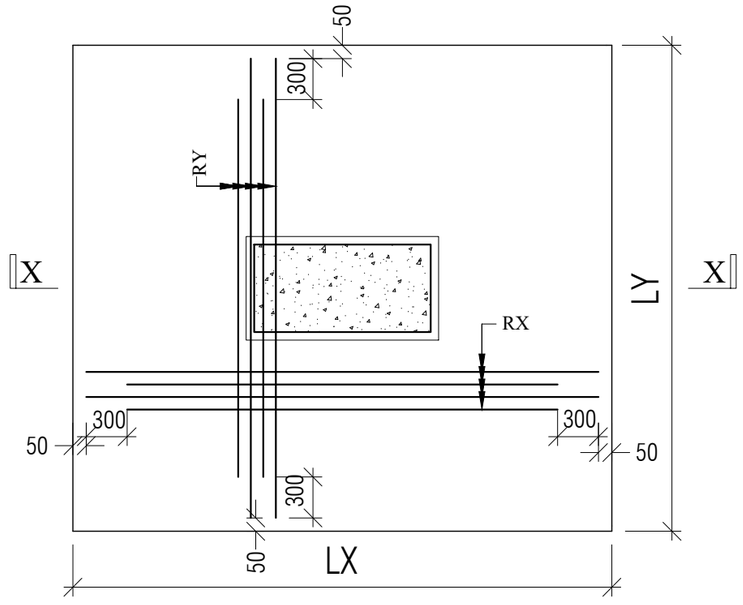
TENDER DRAWINGS



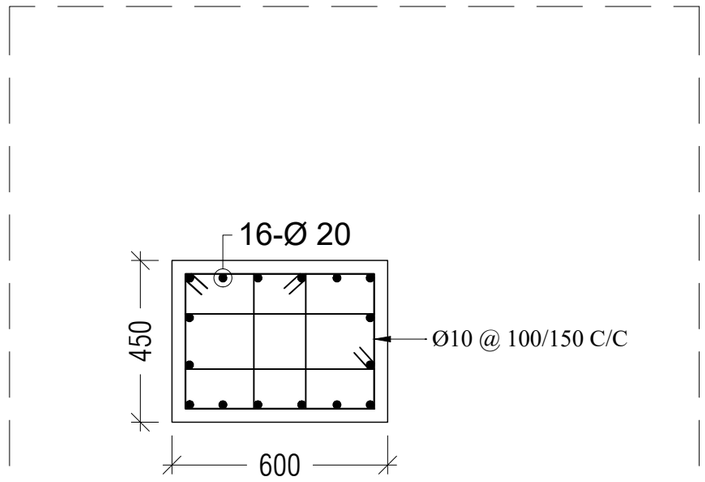
SECTION ON - X-X

SCHEDULE OF FOOTING :

NAME OF FOOTING	SIZE OF FOOTING		THICKNESS OF FOOTING	REINF. OF FOOTING.	
	LX	LY	T mm	Rx	Ry
F1	3000	3000	900	Ø16 @ 150 C/C	Ø16 @ 150 C/C



PLAN OF TYPICAL FOOTING

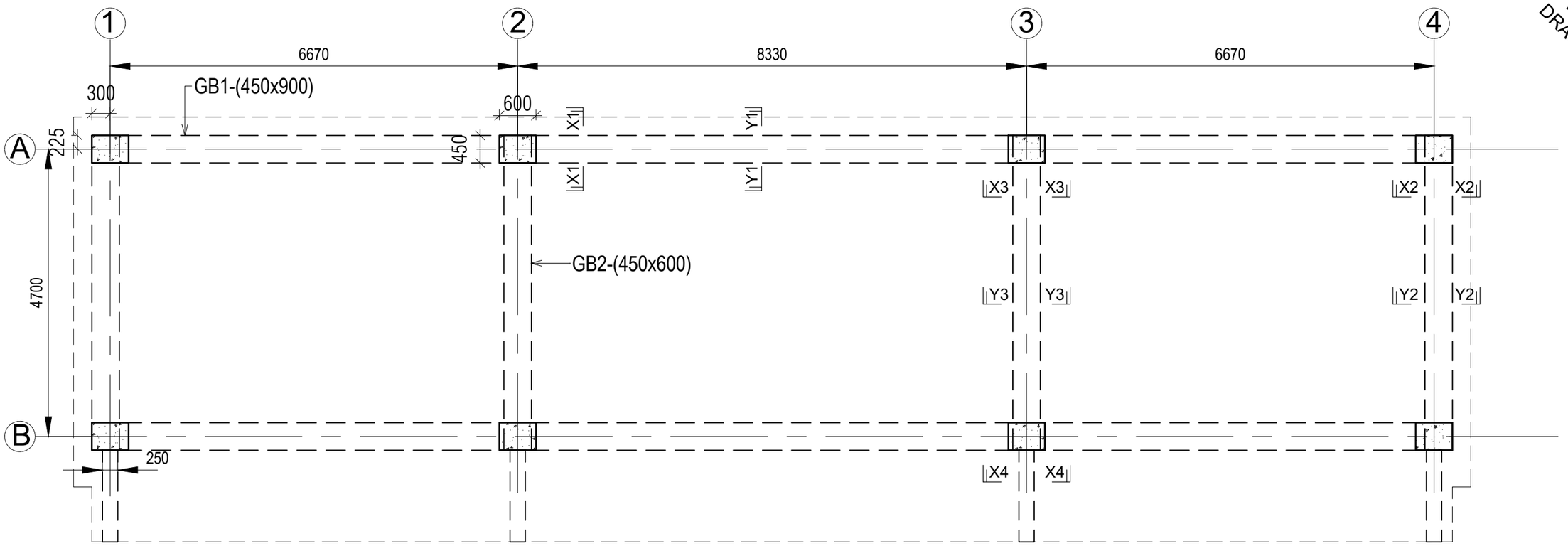


Column Section - C1

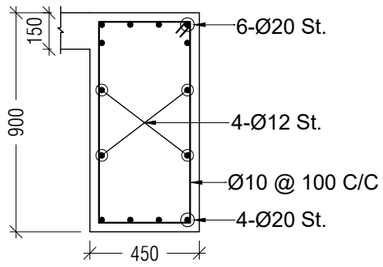
PROJECT: ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER: BANGLADESH NAVY	CONSULTANT: Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Footing & Column Schedule of Generator, Electro-Mechanical and Fire Pump Room CAD BY: SCALE: AS SHOWN

Revision History:		
1.		Date: 30-Apr-2025
2.		Status:
3.		Revision: R-00
Drg No. D-12-B-008		

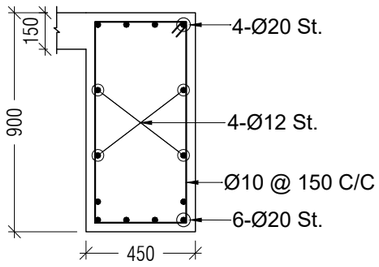
TENDER DRAWINGS



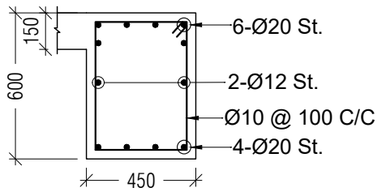
Grade Beam Layout Plan



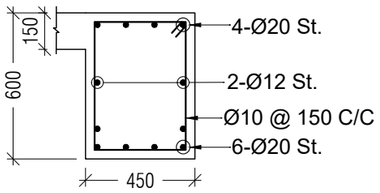
Section X1-X1



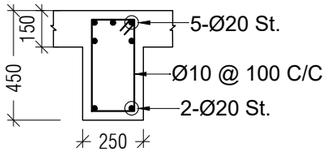
Section Y1-Y1



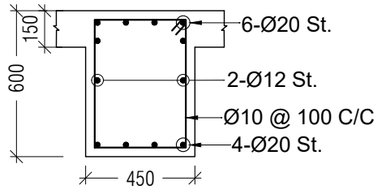
Section X2-X2



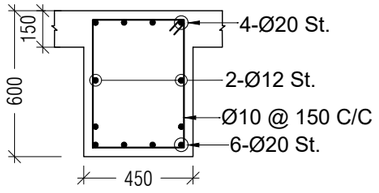
Section Y2-Y2



Section X4-X4



Section X3-X3

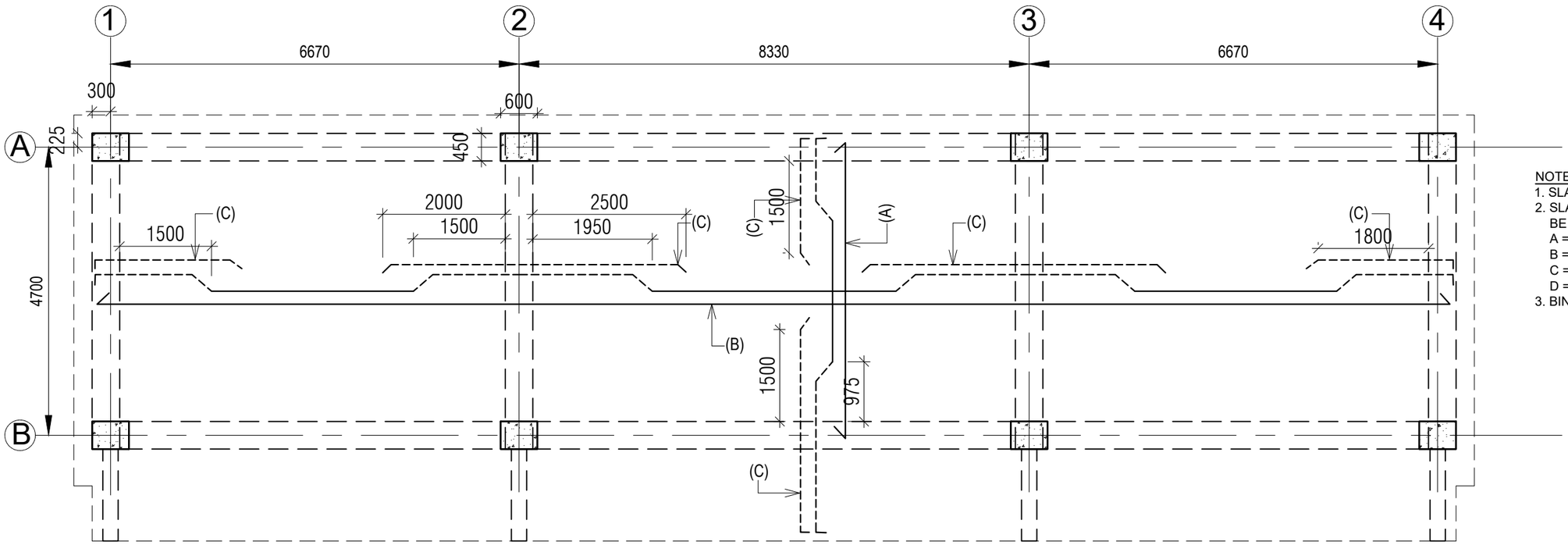


Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Ground Floor Column & Beam Layout Plan of Generator, Electro-Mechanical and Fire Pump Room CAD BY:	Revision History: 1. 2. 3. SCALE: AS SHOWN
				Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-12-B-009

TENDER DRAWINGS



NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 125 C/C ALT CKD.
   B = Ø12 @ 150 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

N

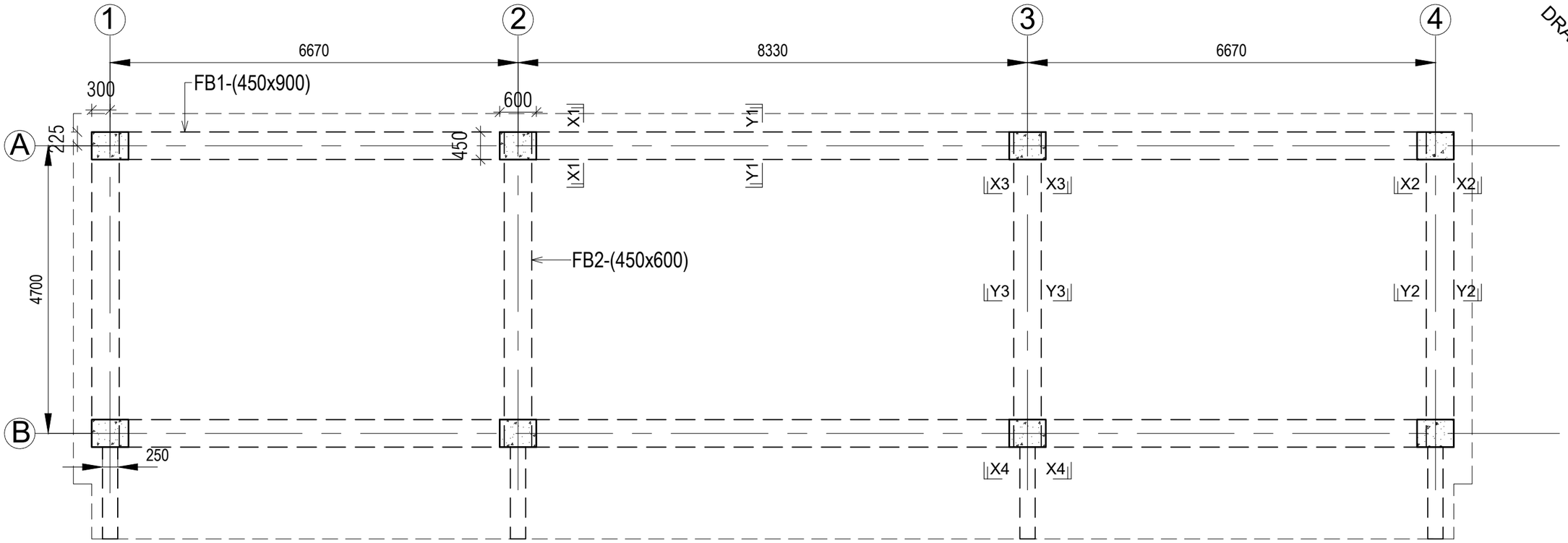
Ground Floor Slab Reinforcement Layout Plan

**All Levels are in Chart Datum

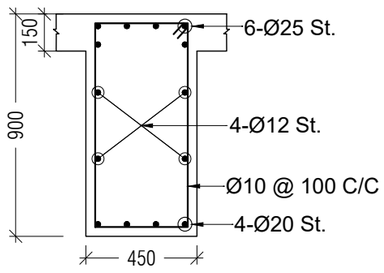
PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Ground Floor Slab Reinforcement Layout Plan of Generator, Electro-Mechanical and Fire Pump Room CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-B-010

Date: 30-Apr-2025
Status:
Revision: R-00

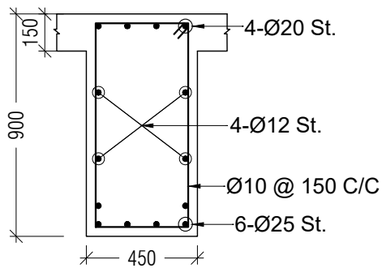
TENDER DRAWINGS



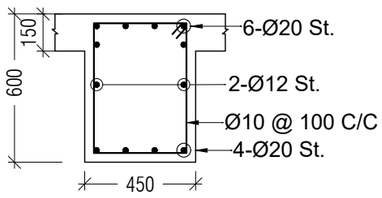
Roof Floor Beam Layout Plan



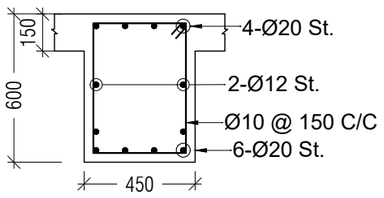
Section X1-X1



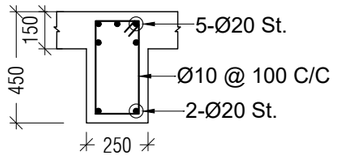
Section Y1-Y1



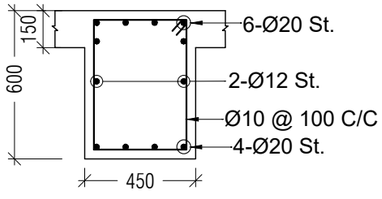
Section X2-X2



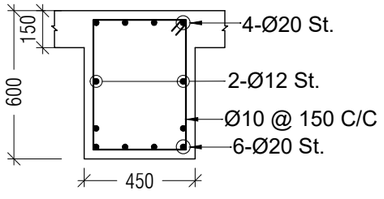
Section Y2-Y2



Section X4-X4



Section X3-X3

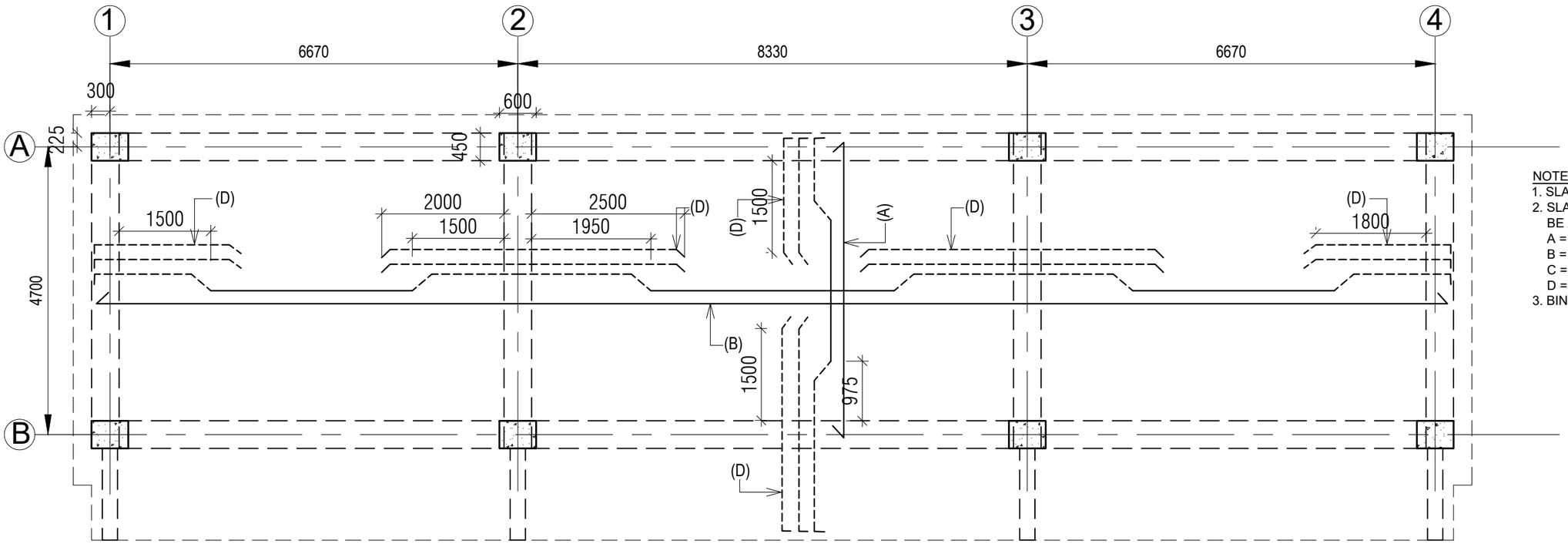


Section Y3-Y3

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Roof Floor Column & Beam Layout Plan of Generator, Electro-Mechanical and Fire Pump Room CAD BY: / SCALE: AS SHOWN	Revision History: 1. 2. 3. Date: 30-Apr-2025 Status: Revision: R-00 Drg No. D-12-B-011

TENDER DRAWINGS



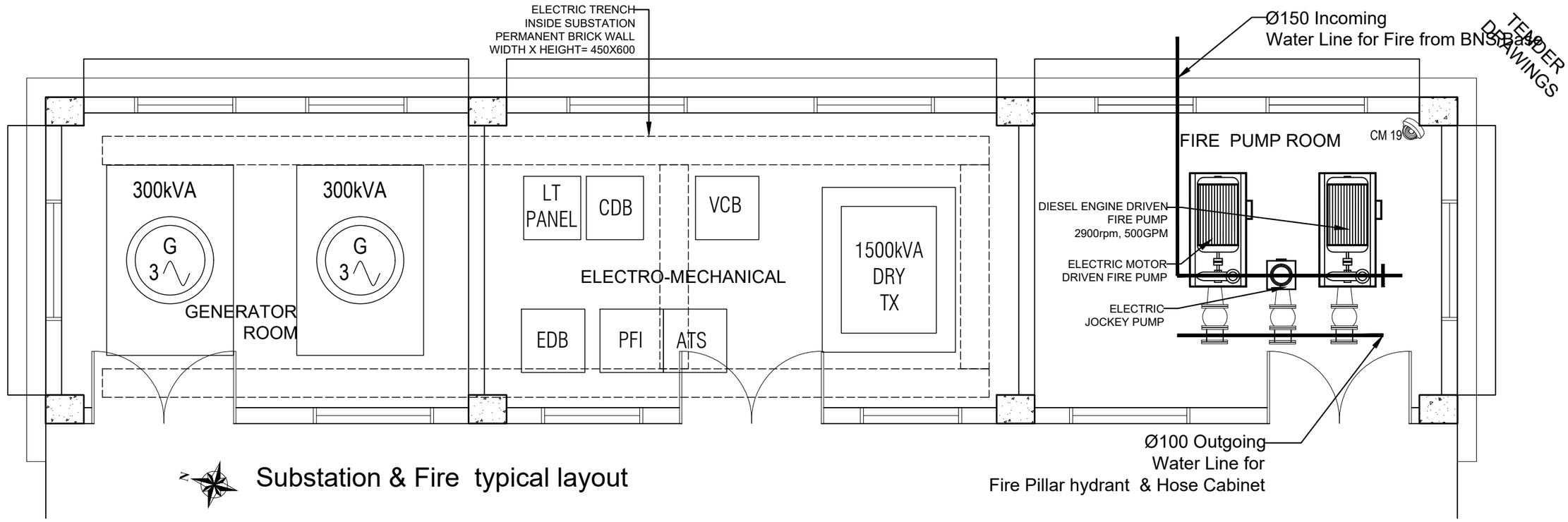
NOTES:
1. SLAB THICKNESS IS = 150
2. SLAB REINFORCEMENT SHALL BE AS FOLLOWS;
   A = Ø12 @ 125 C/C ALT CKD.
   B = Ø12 @ 150 C/C ALT CKD.
   C = 1-Ø12 EXTRA TOP
   D = 2-Ø12 EXTRA TOP
3. BINDERS SHALL BE Ø10 @ 150 C/C

N

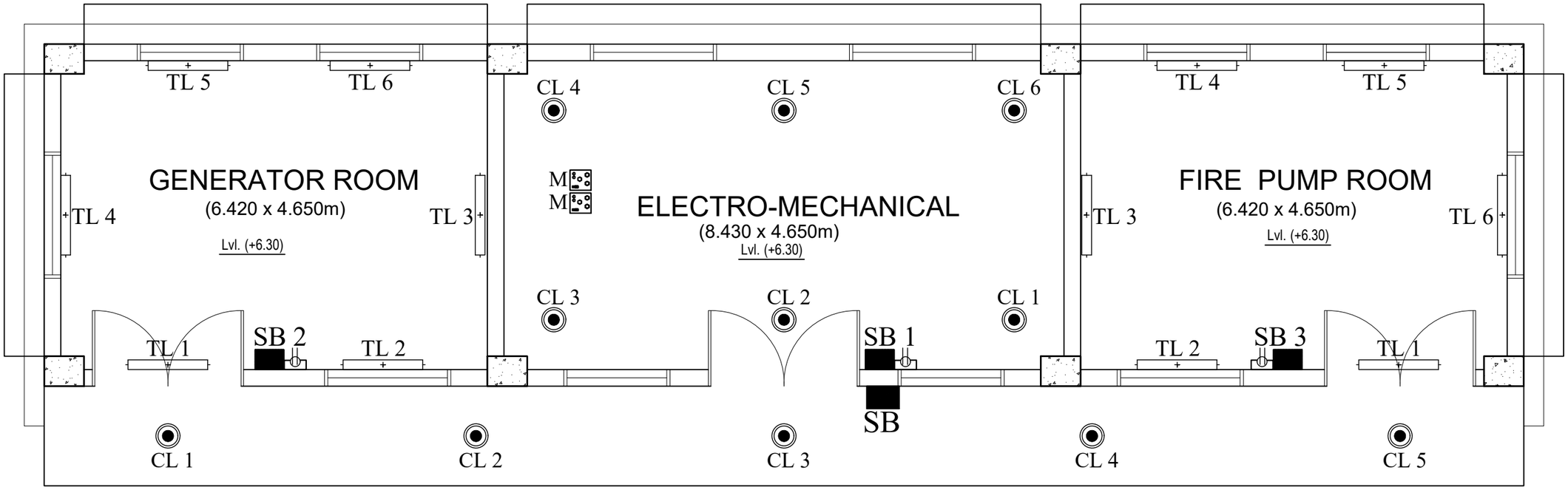
Roof Floor Slab Reinforcement Layout Plan

**All Levels are in Chart Datum

PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Structural Design of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Roof Floor Slab Reinforcement Layout Plan of Generator, Electro-Mechanical and Fire Pump Room CAD BY: SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-B-012	Date: 30-Apr-2025 Status: Revision: R-00

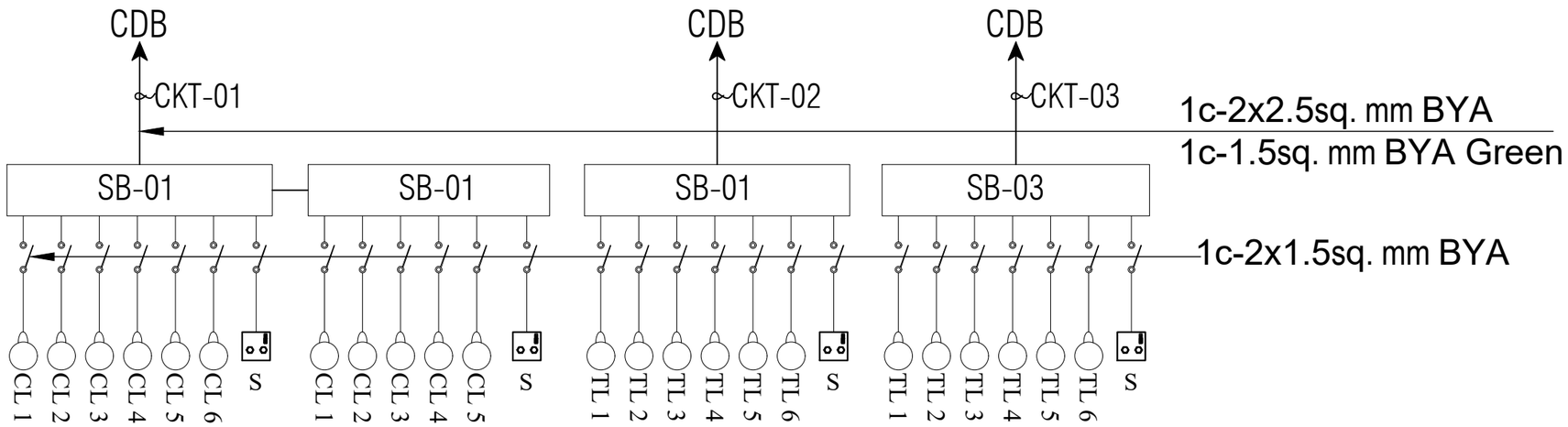


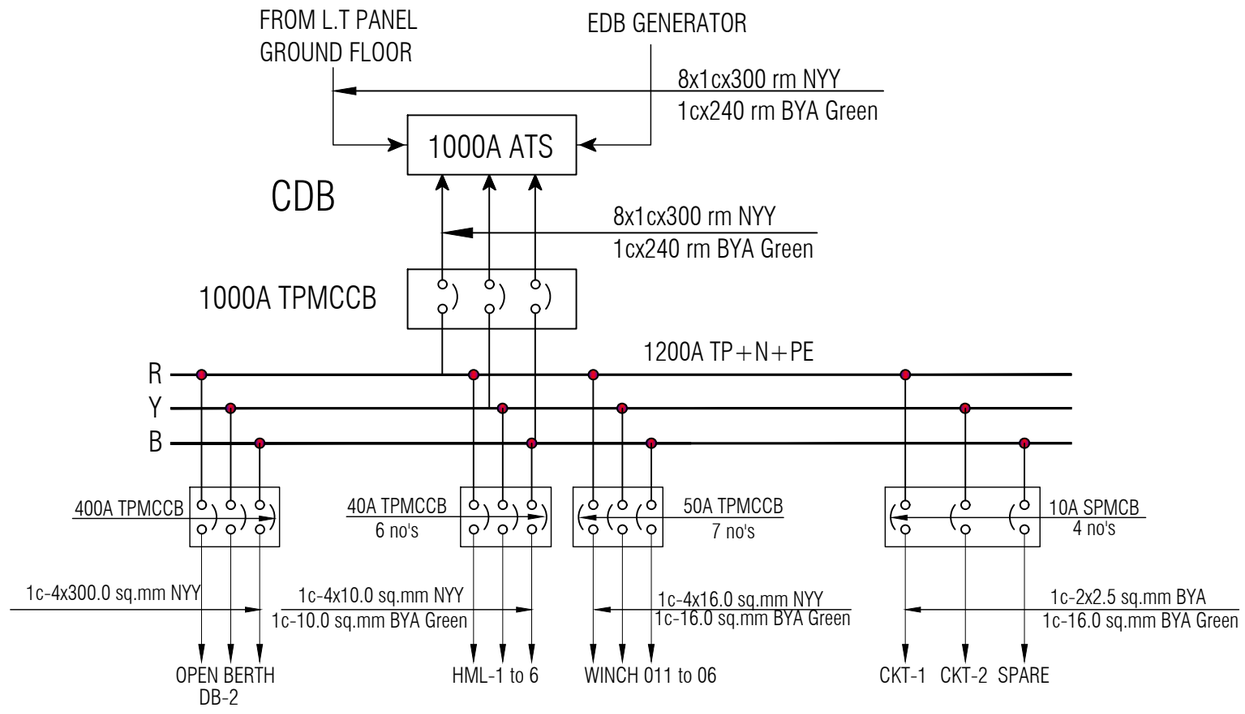
Substation & Fire typical layout



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Typical Layout Plan of Substation and Fire Hydrant System & Eelctrical Fixture Details SCALE: AS SHOWN	Revision History: 1. 2. 3.	Date: 30-Apr-2025 Status: Revision: Drg No. D-12-C-001

TENDER DRAWINGS



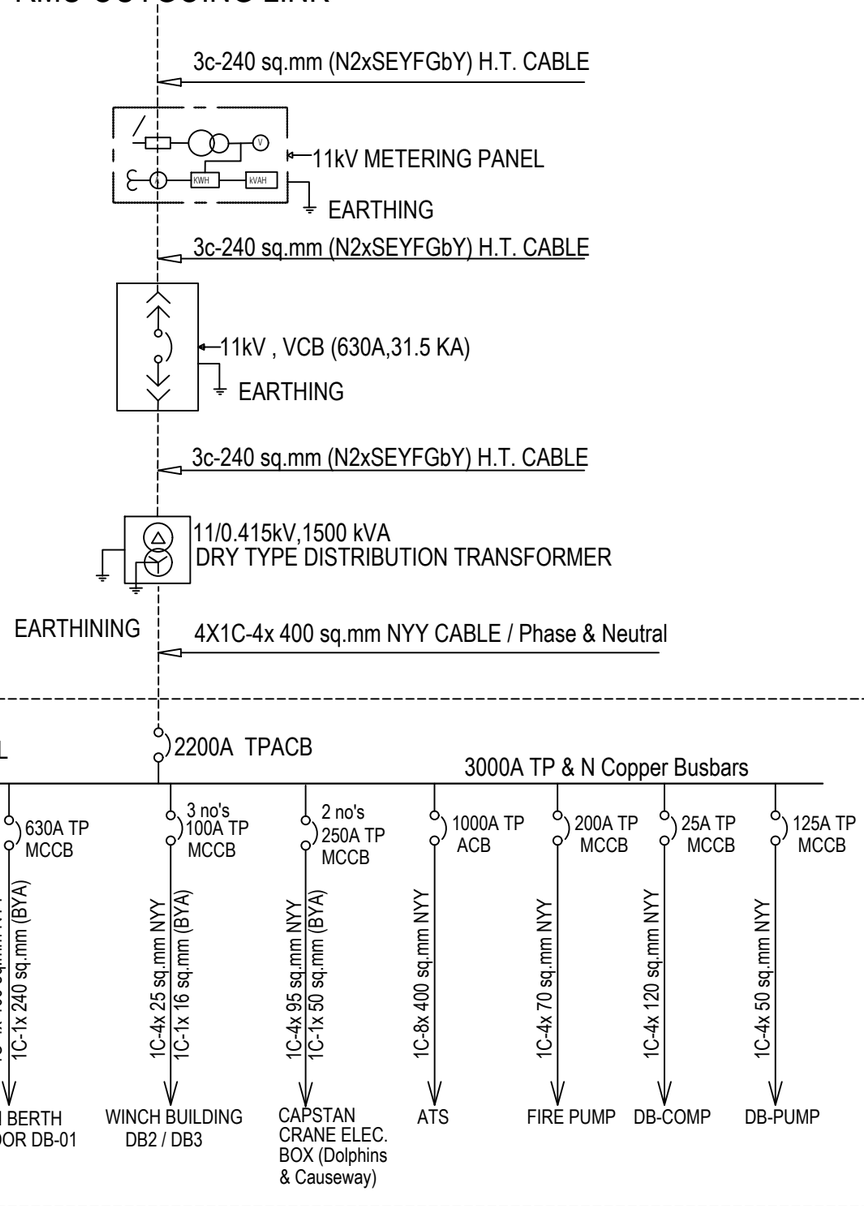


PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Electrical Single Line Diagram of Common Distribution Board CDB (Both Normal and Emergency Power Available) SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-C-002

Date: 30-Apr-2025
Status:
Revision:

TENDER DRAWINGS

FROM SOURCE-01 SUBSTATION-01
RMU OUTGOING LINK



PROJECT ENGINEERING, PROCUREMENT AND CONSTRUCTION INCLUDING INSTALLATION OF SHIP DOCKING AND REPAIR FACILITY AT MONGLA	OWNER BANGLADESH NAVY	CONSULTANT Bureau of Research, Testing and Consultation (BRTC) BUET, Dhaka-1000, Bangladesh.	DRG. TITLE: Electrical Drawings of Generator, Electro-Mechanical and Fire Pump Room SHEET TITLE: Electrical Single Line Diagram of 11/0.4kV Dry type Distribution Substation SCALE: AS SHOWN	Revision History: 1. 2. 3. Drg No. D-12-C-003 Date: 30-Apr-2025 Status: Revision: