36.19 HV Line

36.19.1 HV Overhead Line

The Contractor shall be responsible for installing overhead line from the nearest available source up to bridges and roads. An 11 kV line may be constructed by the Contractor or by BPDB on a payment basis but for either case the Contractor shall be liable for ensuring the construction to quality and standard.

36.19.1.1 HV Poles

The position of each pole shall be pegged in line and approval shall be obtained from the Engineer.

The Contractor shall carry out the installation of poles in accordance with the standards of BPDB. Planting depth of the pole shall be 1/6 of the total height of the pole, unless otherwise specified by the Engineer.

The poles shall be supplied with 450 x 450 x 6 mm galvanized base plates with fixing nuts and bolts and washers.

36.19.1.2 Stringing of HV Conductor

Overhead conductors shall be pre-tensioned for a period of not less than one hour at a tension equal to one third of the breaking load of the conductor. After pre-tensioning for not less than one hour, the conductor shall be sagged, using sag boards according to the sag chart provided by the manufacturers of the conductor. At the end of a 24 hour period the sag shall be checked by the Engineer and the tension shall be adjusted by the Contractor if necessary.

36.19.1.3 Binding Conductors

Each conductor shall be bound to its associated pin/shackle dead-end/section disk insulator set with proper armouring and preformed dead-ending.

Prior to lifting the conductor on to the insulators, the insulator shall be wiped with dry cloth to remove any dirt or dust.

36.19.1.4 Stays

Where specified by the Engineer, stay wires shall be attached to the pole and tensioned by the Contractor using a turnbuckle attached to the stay.

36.19.1.5 Overhead Obstructions

Where telephone lines, power lines or other overhead obstructions cross the route of the line being installed, the Contractor shall adopt measures to overcome the obstructions without damaging the existing lines. The Contractor shall provide temporary guards or support to

carry out the work safely.

36.19.1.6 Clearing the Right of Way

Clearing of the right-of-way of all trees and shrubs shall be carried out to a distance of 3.05m on both sides of the center of the MV line, unless otherwise instructed by the Engineer.

Prior to cutting any trees a written confirmation from the relevant authority must be available with the Contractor.

The Contractor shall comply with all national and local regulations regarding barricades, detail arrangements and warning signs. Damage to roads, footpaths, bridges, ditches etc., caused by the Contractor shall be repaired at his expense.

36.19.2 HV Power Cabling

36.19.2.1 Type of Cable

The 11 kV feeder cables shall be cross linked polythene insulated, single wire armoured, PVC sheathed cable, 6350/1100 Volt grade with stranded copper conductor in accordance with IEC 502. Before any cables are ordered, the Contractor shall confirm with the Engineer that they are of the correct grade and quantity for the supply voltage and that they are suitable for direct burial in the ground materials at the site.

36.19.2.2 Cable Terminations

Cables shall be terminated using a method recommended by the cable manufacturer.

36.19.2.3 Cable Size

The cables shall be sized taking into account the system short circuit rating and the load on the cables.

36.19.2.4 Installation of HV Cables

All cable routes shall be confirmed and agreed with the Engineer. All cables shall be installed in continuous lengths and joints will only be permitted where it is necessary to suit standard drum lengths or specifically shown on the drawings.

The radii of all cable bends shall be correctly related to the type and overall diameter of the cable.

Cables under roads, hard shoulders or other permanent surfaces shall be drawn into ducts.

(a) Cables buried directly in the ground

Cables shall be laid at depths specified herein in excavated trenches. The floor of the trench shall be covered with 100mm of clean sand before laying the cable.

After laying, the cables shall be covered with additional clean sand well punned over and around the cables to a level of 100mm above the uppermost cable. Mechanical punners shall not be used.

At points of cable entry into masts and ducts, the sand shall be packed round the cables to give a firm foundation.

Suitably inscribed interlocking cable covers shall be carefully centered over cables buried in verges. Cable covers shall be constructed of unreinforced concrete or 1st class brick in accordance with BS 2484 and shall have widths as shown on the approved working drawings, the lengths of the covers shall be not less than 600mm.

After backfilling to a level of 300mm above the cables, yellow colored plastic warning tape shall be laid above each cable, after which backfilling may be completed. Warning tape shall be printed in Bengali and English 'CABLE- DANGER' and the space between adjacent inscriptions shall not exceed 150mm.

Trenches shall be backfilled using the original spoil, and consolidated. Surplus soil shall be removed from the site by the Contractor to a location agreed with the Engineer. Backfilling shall be completed as soon as possible after the cables have been laid, and in any case within seven days of the trench having been opened. Surface reinstatement shall be carried out by the Contractor.

The Contractor shall supply and install suitably inscribed cable route markers at 50m intervals in the final surface above all cable routes except those in the central reservation, with the cable direction correctly indicated on each marker in a permanent fashion.

(b) Cables in ducts

Ducts shall be provided under roadways. They shall be of high-pressure water grade PVC conduit.

Prior to drawing cables into any underground ducts, the Contractor shall satisfy himself that such underground ducts are provided with continuous draw-wires, are run straight and true throughout their length and are mopped clean and contain no obstructions. Should any duct be found to be damaged or obstructed, the Contractor shall immediately advise the Engineer. No claim will be allowed for loss of time or materials resulting from attempts to draw cables through damaged or obstructed ducts, and no claim will be allowed for replacement of cables damaged by such obstructions.

On completion of each section of the Works, all underground duct bores, whether occupied by cables or not, shall be sealed with an approved plug and compound by the Contractor.

3619.2.5 Depths and Separation of Buried HV cables

Buried HV cables shall be laid at depths below finished ground level of not less than 900mm.

Where LV cables are laid in the same excavated trench they shall be separated by a horizontal distance of not less than 100mm.

36.20 LV Distribution Cabling

36.20.1 Types of Cables

The following types of cables shall be used for the works:

Distribution cables from distribution panels to the lighting columns	PVC insulated, PVC sheathed multicore cable 600/1000V grade with stranded copper conductors in accordance with BS 6346.
Internal wiring of lighting columns and masts	EPR insulated and CSP sheathed cables 450/750V or 300/500V grade as applicable with stranded copper conductors in accordance with BS6007 or BS6500 as applicable.
Earth connections	PVC insulated, green/yellow colour, single core cable 450/750V grade with stranded copper conductors in accordance with BS 6004.

Before any cables are ordered, the Contractor shall confirm that they are suitable for direct burial in the ground materials at the site.

36.20.2 Installation of Cables

All cable routes shall be confirmed and agreed with the Engineer. All cables shall be installed in continuous lengths and joints will only be permitted where it is necessary to suit standard drum lengths or specifically shown on the drawings.

The radii of all cable bends shall be correctly related to the type and overall diameter of the cable.

Cables under roads, hard shoulders or other permanent surfaces shall be drawn into ducts.

Foundation bases for columns shall be provided with integral ductways in accordance with the drawings to be provided by the Contractor.

Ducts shall be provided under the footway to the column bases on the bridge and shall be complete with draw-wires.

Prior to drawing cables into any ducts, the Contractor shall satisfy himself that such ducts are

provided with continuous draw-wires, are run straight and true throughout their length and are mopped clean and contain no obstructions. Should any duct be found to be damaged or obstructed, the Contractor shall immediately advise the Engineer. No claim will be allowed for loss of time or materials resulting from attempts to draw cables through damaged or obstructed ducts, and no claim will be allowed for replacement of cables damaged by such obstructions.

On completion of each section of the Works, all duct bores, whether occupied by cables or not, shall be sealed with an approved plug and compound by the Contractor.

36.21 LV Switchgear and Distribution Equipment

36.21.1 Control of Lighting Circuits

The power supplies to the road lighting systems shall be controlled by conductor units accommodated in the LV distribution panels. The coils of the conductors shall be energized by time switches fitted adjacent to them. Two time switches shall be provided in the power point and connected in parallel such that one time switch will be available to energize the control circuits in the event of failure of the other one.

36.21.2 Isolator Switches

Isolator switches shall be fault make, load break type and shall be interlocked to prevent access with the switch or fuses in the ON position. Mechanical ON/OFF indicators shall be provided together with padlocking facilities in the OFF position.

The switches shall be double-break with interphase barriers such that, in the OFF position, the moving portion including the fuses can be completely withdrawn from the housing.

36.21.3 Distribution Boards or Panels

Distribution boards shall be arranged such that all single phase miniature circuit breakers on one phase are in horizontal banks and a permanent means of identifying phases shall be provided. Terminals for outgoing cables shall be adequately sized for the cable sizes and all terminals shall be such that no damage is caused to cable conductors when the terminal is tightened down. There shall be as many points in each neutral busbar and earth bar as there are single phase circuits.

Miniature circuit breakers shall embody thermal overload and magnetic short circuit tripping devices.

36.21.4 Conductors

Conductors shall be to Class Mechanical Duty and Utilization Category AC4 in accordance with British Standard 5424 part I and shall be suitable for use on inductive circuits and continuously rated. They shall be of the block type with coils operating at 230 Volts and protected by a suitably rated miniature circuit breaker.

36.21.5 Time Switches

Time switches shall be synchronously driven with a solar dial, calibrated for each section. A manual over-ride switch shall be provided.

Clock circuits shall be fed through suitably rated miniature circuit breakers.

36.21.6 Charts and Labels

Each item of equipment shall have a designation label of laminated plastic materials screwed to the front of the cover.

Characters shall have the following minimum height:

Main labels	20mm
Secondary labels	4mm

A circuit designation label shall be fitted to the inside cover of distribution boards. This shall be printed or typewritten and shall be protected by a cover of suitable plastic material.

All labels and charts shall be printed in both Bengali and English languages.

36.22 Earthing

36.22.1 General

All metal enclosures of electrical equipment, switchgear, conduits, cable armouring, cable tray or ladder rack, lanterns and columns shall be effectively bonded to earth in compliance with British Standard Code of Practice No. CP 1013 and with the current Edition of Regulations, for Electrical Equipment of Buildings published by the U.K. Institution of Electrical Engineers or other equivalent Standards.

Throughout the Works separate earth, earth continuity and bonding cables shall be used and these shall be independent of any power cables. The cables shall be effectively connected at each end to the associated earthed metal work of switchgear or equipment.

The impedance of the earth system shall be of minimal value to permit the operation of circuit protective devices in minimal time and the resistance to earth of any part of any earthed metal shall not exceed 1 ohm nor shall it be possible for the potential to earth of any metalwork to rise above 40 Volts.

All earth, continuity and bonding conductors shall be PVC insulated colored green/yellow and final connections shall be made using compression lugs, bolted to equipment and earth bars by means of high tensile steel bolts. Sweated connections shall not be used.

36.22.2 Services Earthing

Conductors used to connect lighting columns shall be 12 swg HDBC copper conductors and laid alongside the associated power cable. Final connections shall be made using compression lugs, bolted to equipment and earth bars with locknuts or locking devices, Sweated connections shall not be used.

36.23 Tests

36.23.1 Factory Tests

The following tests shall be carried out in accordance with Article 36.7 of this Specification:

(a) All materials, plant and equipment shall be routine tested in accordance with the appropriate British Standard or other approved National Standard.

(b) 10 % of the columns shall be selected (or nominated) by the Engineer for non-destructive testing of the welding, prior to galvanizing as follows:

(i) Butt Welds - each butt weld shall be fully radiographed in accordance with BS 2600 or ultrasonically tested in accordance with BS 6072.

(ii) Fillet welds - fillet welds to base plates shall be magnetic crack detected in accordance with BS 4397.

(iii) Base Plates - shall be checked by ultrasonic testing for lamellar tearing.

36.23.2 Site Tests

The following tests shall be carried out:

(a) Substations

Tests shall be carried out on all items of equipment and shall include:

(i) Full operation tests to demonstrate the correct performance of all equipment.
(ii) HV pressure and insulation resistance tests.
(iii) Auxiliary cabling insulation resistance test and earth continuity tests.

(b) Cables and Earthing Systems

(i) High voltage pressure tests on all cables including joints and terminations. Internal wiring of columns, masts and signs shall be disconnected during these tests.

(ii) Phasing and continuity checks on all cables.

(iii) Resistance and impedance tests of earthing cables and earthing systems.

(c) Columns and Lanterns

(i) After erection of the lanterns, all columns shall be checked for vertical alignment.

(ii) All base compartment doors shall be capable of being easily opened, closed and locked with the keys provided.

(iii) Prior to energizing, the internal wiring and electrical components of each complete column assembly shall be tested for insulation resistance with a 1000 Volt megger and for earth continuity.

(iv) Following the energizing of a complete circuit, after at least a period of 60 minutes for stabilization of the lamps, the voltage at each lighting column shall be recorded and the control gear units adjusted to the appropriate tapping to match the voltage at the cutout, based on a 230 V output at the distribution panels.

(v) Illumination values shall be recorded at selected sites at least 2 hours after sunset. Sets of readings shall be taken at intervals of 500 meters.

36.24 Applicable Standards

British Standards applicable to this Section of the Specification include:

LV Air Break Switches & Isolators	BS 5419
Busbars and Busbar Connections	BS 159
Circuit Breakers up to 1kV	BS 4752
Distribution Boards	BS 5486
Miniature Circuit Breakers	BS 3871
Conductors	BS 5424
Road Lighting	BS 5489, BS 5649 Part-2 :1978
LV Switchgear	BS 5486
HV Switchgear	BS 5227
Luminaire classification	CEE/CIE
Photo cell device	NEMA

SECTION 37
BRIDGE TOLL SYSTEM

37 BRIDGE TOLL SYSTEM

37.1 General

It is proposed that users of the completed Rupsa Bridge will be charged a toll and hence appropriate toll collection facilities will be required. It is intended that the tolls collected will be used to pay for the operation and maintenance of the bridge.

For the proposed Bridge Toll System the Engineer will prepare design criteria. The Contractor will then be requested to prepare and submit detailed design specifications and price proposal for a toll facility meeting all of the design criteria. Following necessary checking and approval by the Engineer, it is intended that the Contractor will then be instructed to construct and commission the toll facility.

37.2 Bridge Toll System Design Criteria

The following general approach will be taken in the formulation of design criteria.

Design criteria for the development of a toll plaza concept and ultimately the preparation of detail designs is dependent upon many factors particularly traffic demand, vehicle types, available right of way, the tariff and method of collection. In developing nations such as Bangladesh, commercial traffic can take on many forms which are frequently overloaded placing additional stress on the carriageway road surface and on bridge structures. This is a very relevant issue for the Rupsa Bridge since its operation and maintenance will be paid for by tolls. Therefore, vehicle axle weight must be considered.

While numerous methods of toll collection might be employed, it is most likely that manual or attended toll collection will be recommended. The configuration of the toll plaza in terms of the number of toll gates will be set by the estimated initial and future traffic demand including vehicle mix and typical processing rates that might be achieved trough a toll gate.

Other criteria which must be established to design a toll plaza include the number of toll lanes, toll gate height clearances and widths, the queue or vehicle storage length prior to the toll gates, and geometric transition of the pavement required to facilitate an orderly vehicle dispersion from the main carriageway road to available toll gates and the safe merge of vehicles from the toll gates back to the main carriageway road. Other elements such as drainage, pavement design, lighting, signals and security will also be addressed.

A further plaza design element that will be considered is the toll plaza administration and operations building. Here administrative, management and financial functions as well as the operation and supervision of the toll collection are carried out. In addition, utilities are distributed to serve the various plaza power, communications and surveillance needs plus maintenance needs of the toll equipment and facilities. The sizing of this facility is largely a function of staff, the toll facility organizational structure and their prescribed relationships.

Design Criteria will be in general agreement with design practices used by US toll facilities. [Reference information in this regard can be found in a book published by the US National

Academy of Science Transportation Research Board. "Entitled Toll Plaza Design Synthesis No, 240."]

It is anticipated that the Bridge Toll System will be similar to that recently constructed at the Bangabandhu Bridge across the Jamuna River in Bangladesh.

37.3 Bridge Toll System Design (by Contractor)

37.3.1 Preliminary Design

Upon receipt of the design criteria from the Engineer, the Contractor shall prepare preliminary design plans for the toll facility including preliminary details of site plans, structural, electrical and mechanical systems, toll equipment and communications, signing, lighting, and architectural plans and specifications for the administration building, toll booths and canopy. These preliminary designs will be submitted to the Engineer for review and will be checked for compliance with the design criteria and concept.

The Contractor shall also submit a preliminary cost estimate and construction schedule.

37.3.2 Design Coordination and Final Design

Upon receipt of review comments on the preliminary design, it is anticipated that the toll facility specialist from the Engineer's personnel will meet with the Contractor's representative to discuss final design details. The Contractor will then be required to prepare complete design plans and specifications for the Bridge Toll System. This will include site plans, civil roadway design, structural, electrical and mechanical systems, toll equipment and communications, signing, lighting, and architectural plans and specifications for the administration building, toll booths and canopy. These designs will be submitted for final review and approval subject to compliance with the design criteria and with referenced design standards and codes.

The submittal shall also include a fully detailed cost proposal and construction schedule for the work.

37.4 Bridge Toll System Installation and Trial Operations

Upon the Engineer's approval of the Bridge Toll System Design, the Contractor will install the Bridge Toll System. The Contractor will be responsible for training of the Employer's personnel in the operation of the facility and will provide the services of a representative of the system designer for a Trial Period of 30 days following the initial commissioning of the facility to address any problems that may arise in the commissioning of the facility. Any problems arising during the Trial Period must be corrected to the satisfaction of the Engineer and the 30 days Trial Period will be again restarted until such time as 30 days of trouble free operation are completed.

See also Section 0.4.5 and 0.4.6 for general requirements regarding the training of the Employer's personnel and the preparation of an Operation and Maintenance Manual.

SECTION 38
PIER PROTECTION WORKS

38.1 Dredging and Hydraulic Fill

38.1.1 General

Dredging will be required to form the surface for the concrete block pitching. The formed surface is subsequently to be covered with protective concrete blocks. Dredging will also be required as part of temporary works for construction access, raising of working sites, and similar operations. The dredged spoil shall be stockpiled for future use, disposed off Site or be replaced in the river, as directed by the Engineer. All temporary and permanent movements of dredged material shall have the prior approval of the Engineer in writing.

Hydraulic filling will be required for the part of the pier protection works.

38.1.2 Dredging

38.1.2.1 Equipment

The Contractor shall employ dredging equipment which shall have a theoretical (combined) dredging capacity, having due regard to inevitable delays, well in excess of the actual capacity required to complete the dredging in the working periods available.

Dredging equipment shall be equipped with such instruments and devices, including positional equipment, slope dredging computers, as are necessary to accurately finish slopes of the permanent works within the tolerances specified.

38.1.2.2 Working Methods

The Contractor shall, until completion of the pier protection works to any component of the protection works or any relevant part thereof, be solely responsible for the stability of any permanent or temporary slope.

The Contractor shall restrict the height difference between subsequently dredged layers ("bench height") as mach as possible, but in any case not more than 2m in areas adjacent to permanent slopes. The Contractor's particular attention is drawn to the large differential heights which sill exist between the ground level of the flood plain and the "underside" of the first layer which could possibly be dredged with a cutter suction dredger during low water levels in the river. To avoid or limit the risk of slope failure near the permanent works, the Contractor shall reduce this "bench height" near permanent slopes, which could reach 8m or more if no special measures were taken to reduce the bench height.

The Contractor is free to select the gradients of temporary slopes, subject to a limitation of the risk of a slope failure to a level acceptable to the Engineer, but slopes should not be steeper than 1:2.5.

To reduce the risk of flow slides due to the presence of higher mica content/loose sand packing or any other reason, all slopes shall first be formed slowly by an initial cut not

encroaching within 3m of the final slope, but parallel to that slope at a mean horizontal distance of 4m. After a period of ten days the final trimming of the slope to the design profile may be made, working from the top downwards.

The Contractor shall submit detailed slope stability calculations for the approval of the Engineer, whereby due attention shall be given to the influence of the work method proposed by the Contractor. Notwithstanding any approval of stability calculations for any temporary or permanent slope, the Contractor shall remain fully responsible for the stability of such slopes. Such approval of the dredging plan by the Engineer will not relieve the Contractor from his responsibility of safe dredging.

The work plan for the dredging operations (see also Article 38.1.4) shall be subject to the prior written approval by the Engineer.

38.1.3 Hydraulic Fill

38.1.3.1 General

All material dredged shall be deposited in the disposal areas approved by the Engineer. Temporary disposal areas include the Contractor's working area and areas required to be raised as per direction of the Engineer.

Except as required for temporary works like access to working areas and filling the Contractor's working area, no deposition of dredged material in the Rupsa river will be accepted, unless prior approved by the Engineer in writing.

38.1.3.2 Placing of Fill by Hydraulic Means

Fill material placed by hydraulic means, in disposal areas shall be allowed to achieve its own natural consolidated density.

Prior to placing any fill by hydraulic means unsuitable material as specified in Clause 22.1.3.1(c) as well as trees, shrubs and structures shall be removed from the area to be filled.

Excavated material reclaimed by hydraulic dredging plant or equipment shall be placed in such a way that a uniform fill will be obtained, avoiding pockets or layers of silt and/or clay. When necessary, the Contractor shall divide the areas to be filled, by the construction of temporary containment bunds of suitable sand filled bags, into compartments of adequate dimensions,

The Engineer may order the Contractor to excavate any pocket of fines and backfill such excavation with material which meets the specifications for fill.

The working method for the discharge of return water, silt and other fines during dredging and reclamation operations requires the approval from the Engineer prior to commencement for those operations.

The fines separated from dredged material placed on shore shall be disposed of at locations to the approval of the Engineer. For silt retaining areas, the Contractor shall design the type and size of the overflow system which may consist of drop inlets, adjustable weirs or any other structure with a discharge pipeline or route to the river (if

applicable).

Where necessary, the Contractor shall execute temporary earthworks and install pipelines and return water pumps to keep fill areas and adjacent areas clear of water.

After completion of the hydraulic fill operations the Contractor shall remove all temporary earthworks, structures and equipment at his own expense.

38.1.3.3 Water Measurement

Any water discharged at the site, into natural or existing water courses other than the Rupsa River in connection with the dredging works, shall never contain more than 4,000 ppm of soil material. Retaining dikes shall have such, properties that fine soil particles will not percolate through the dike. The Contractor is not allowed to pump any water in enclosed areas with the purpose to dilute the effluent from the area in order to try to meet the requirements of maximum content of 4,000 ppm in the effluent.

All the equipment, structures and devices the Contractor intends to use for the management, transport or discharge of water requires the prior written approval of the Engineer.

38.1.4 Working Plan

The Contractor shall submit details of working methods, including details of equipment and survey and positioning equipment involved, to the Engineer within 45 days after receipt of the Order to Commence. Dredging operations required for temporary works shall be included in the plan.

A detailed plan shall include:

- type of equipment proposed, including details of performance, both floating and land based,
- lengths of floating and land based pipe lines proposed,
- working method and sequencing of dredging work,
- working method and sequencing of reclamation work,
- drainage provisions,
- slope stability calculations for temporary slopes,
- details of protective bunds in the river required for protection of permanent works during their construction,
- quality assurance plan and provisions.

Approval of the Contractor's work plan will only be given after the Contractor has demonstrated to the satisfaction of the Engineer that the minimum requirements of the

Specification can be met. It is anticipated that approval of the Engineer will be given within 20 days of receipt of a satisfactory proposal.

38.1.5 Tolerances

The tolerances of dredging works required for the permanent works, measured in a vertical plane are ±250mm.

Notwithstanding the above, the smoothness required in finished dredged slopes shall be to the standard required for the proper placement of the geotextile as determined by the Engineer in the field. Refer also to Clause 38.3.8.

The tolerances on the level of the filled areas shall be ±100mm.

It is expected that the Contractor will provide the services of suitably experienced construction divers to verify that these tolerances have been achieved.

38.2 Protection Works

38.2.1 General

This Article of the Specification covers the requirements for the construction of pier protection works.

The actual river morphology and bathymetry at the time of construction may have changed significantly from that used for design, the design of the pier protection may require modification. The Contractor must schedule his work plan in such a manner that the time required for such design modifications (normally eight weeks) will not hamper the overall progress. No expansion or time of financial claim shall be accepted for such design change.

The following types of pier protection will be applied:

a) Concrete block pitching on geotextile underlayer;
b) Dumped concrete block rip rap, placed under water.

In addition to these types of pier protection, protection will also be provided to parts of the pier protection works along the perimeter of reclaimed areas and along approach roads to be constructed under this Contract. Such protection will consist of a cladding layer of clayey material to be placed on the dredged and/or excavated material. Requirements for testing of clayey material are covered in Article 22.1.3.5.

38.2.2 Codes and Standards

Codes and standards applicable to materials and workmanship are mentioned in the relevant articles of this Specification.

38.2.3 Materials

a) Geotextiles and accessories shall comply with the requirements of Article 38.3.

b) Concrete shall comply with the requirements of Article 38.4.

c) Clayey soil for cladding layers shall have an intermediate or high plasticity (AASHTO T89, T90); the percentage of clay minerals (viz, particles smaller than 0.002mm) shall not be less than 15 percent.

d) Gravel for filter between geotextile and concrete block pitching shall have the gradation of D15: 1.10mm, D50: 5.00mm, D85: 19.00mm.

38.2.4 Types of Pier Protection and Specific Requirements

38.2.4.1 Concrete Block Pitching on Geotextile Underlayer

Concrete block pitching shall be used for protection of MP2 pier. It shall be laid on a proper surface, on geotextile Type-1 underlayer.

The surface to be protected shall be trimmed to an even finish so that when the geotextile underlayer is laid, it is in full contact with the surface.

Gravel shall be laid on 0.1m thickness.

Concrete blocks shall have a nominal size of 0.25 x 0.25x 0.25 m and shall be laid on 2 layers with the next joints staggered.

The blocks shall be accurately cast with smooth, parallel faces, such that when laid they butt closely up to one another leaving no gaps.

38.2.4.2 Concrete Block Underwater

Where rip rap is to be placed around piers underwater, it shall, unless otherwise detailed on the Drawings, be placed directly on to the natural river bed, with a minimum thickness and surface as specified. Mixed sized concrete block shall be used. The mixed portion is 0.30 x 0.30 x 0.30m : 20%, 0.25 x 0.25 x 0.25m : 50%, 0.20 x 0.20 x 0.20m : 30%.

38.2.5 Working Plan

Notwithstanding requirements as to the submittal of method of work statements as part of the tender, the Contractor shall submit details of working methods, including details of plant and survey and positioning equipment involved, to the Engineer within 45 days after receipt of the Order to Commence. In the required submittal the Contractor must accurately describe the process proposed with which he can achieve the minimum required dimensions indicated in the Drawings and Specification.

A detailed plan shall include:

- proposed method of installation and control of tolerances;
- provisions for overlaps;
- the average quantities of materials to be used to achieve the minimum requirements of the Specification;

- provisions for stockpiling, handling and storage of materials;
- performance of survey and positioning systems proposed for placing of materials;
- a quality assurance plan including a monitoring system to verify that the approved working processes and/or methods effectively meet the Specification.

Approval of the Contractor's proposals will only be given after the Contractor has demonstrated to the satisfaction of the Engineer that the minimum requirements can be met.

Such demonstration will be based on the construction of appropriate trial panels of each pier protection work. The trial panels will be of a size large enough to suit the Contractor's working method. Trial panels may form part of the permanent works once a satisfactory standard has been achieved.

38.2.6 Tolerances

The dimensions for pier protection works given in the Specification and in the Drawings are minimum dimensions. Nevertheless it is realized that the thickness of the rip rap will not be constant.

In the Contractor's proposal for a work plan, as referred to in Article 38.2.5, the characteristic parameters for the thickness of the rip rap layer shall be such that none shall have a smaller thickness is less than the minimum thickness specified. Any area where the measured thickness is less than the minimum thickness will not be acceptable and the Contractor will be required to add more concrete block to increase the thickness.

Measurement of layer thickness shall generally be based on levels taken before and after placement of the concrete block. In the dry part the post work leveling may be done with a leveling staff fitted with a half ball of diameter 150mm, at the bottom of the leveling staff. Measurement for thickness of rip rap shall normally be made in lines 5 to 7m apart along the surface of the pier protection work and in each line levels shall be recorded in one meter intervals. The leveling staff could however be placed any where as directed by the Engineer to measure the thickness of the rip rap.

For underwater measurement hydrographic survey of sufficient accuracy in conjunction with experienced construction divers must be done to determine the layer thickness.

38.3 Geotextiles and Accessories

38.3.1 General

This Article of the Specification covers the requirements for the manufacture, handling (transport, storage, assembly, treatment on site), testing and installation of all geotextile and accessory materials required for the Works. Requirement for application/use of geotextiles in the Works is also described in Article 38.2 of this Specification.

The non woven types of geotextile will be required.

All fabrics shall be manufactured by and purchased/obtained from reputable manufacturer(s) of geotextile. The manufacturer(s) shall have ample experience in the fabrication of the type of fabric(s) required and shall have adequate production capacity to meet the delivery schedule.

Before ordering any quantity of geotextile, the Contractor shall submit samples and test reports from an approved independent testing laboratory for each type of geotextile. Only geotextiles represented by approved test specimen shall be used.

38.3.2 Codes and Standards

Geotextiles shall be manufactured and tested in accordance with the appropriate IIS, DIN, BSEN, JIS or ISO standards.

The manufacturer of the geotextiles should be accredited to ISO 9001, or equivalent national standard.

All geotextile materials delivered to the site must be clearly labelled with the name of the manufacturer and the identify of the product in accordance with BSEN 30320: 1993, or equivalent national or international standard. The minimum roll width of any geotextile shall be 5.5m.

38.3.3 Geotextile Type 1

Geotextile Type 1 is for use under the concrete block pitching. It shall have the following characteristics:

- non-woven needle-punched polyester or polypropylene fabric
- minimum thickness 3.0 mm
- minimum mass per unit area 300 g/m^2
- minimum tensile strength (BSEN ISO 10319)
  - machine direction 25 kN/m
  - cross machine direction 25 kN/m
- permeability (when new, no loading), not less than $4x10^{-3}m/s$
- effective opening size (O_{90}), not less than 60 microns and not more than 100 microns.

38.3.4 Joining of Geotextiles to Form Mattresses

Where geotextile rolls are to be joined to form a larger mattress, the joins shall be in accordance with the manufacturer's instructions. The joins may be made at the place of manufacture, or on site, subject to satisfactory demonstration that the joining process will not impair the strength, filtration or permeability characteristics of the geotextile when installed beneath the pier protection.

38.3.5 Lapping of Geotextiles

Elsewhere laps between geotextiles shall be sufficient to ensure that the filtration function of the geotextile is not compromised during the placing of the pier protection.

In no case shall laps be less than 300 mm.

Adequate provision to ensure correct overlays shall be included in the Contractor's Quality Assurance Plan.

38.3.6 Testing of Geotextile

The geotextile manufacturer(s) shall provide production test certificates at the rate of one set per 10 rolls delivered to site. Certificates shall be delivered to the Engineer at least 10 days before that batch of geotextiles is to be incorporated into the works.

The Contractor shall bear the expenses of all the routine tests. Notwithstanding the submission of reports to the effect that the geotextile conforms to the Specification, the Engineer shall at all times be entitled to have additional samples of geotextile tested if he suspects that the geotextile does not conform to the Specification. The Engineer shall only select samples from ends rolls or from already cut geotextile.

38.3.7 Transportation, Storage and Handling of Geotextile

All materials specified in this Article 38.3 shall be transported, handled and stored fully in accordance with the manufacturers recommendations. Geotextiles shall be kept in their protective wrapping provided by the manufacturer's until they are required for use in the Works. Rolls shall not be stacked more than five rolls high and no other material shall be stacked on top of the geotextiles.

Products susceptible to UV degradation shall be wrapped to prevent UV exposure until immediately prior to usage. Unused portions shall be re-wrapped until used. Geotextiles used in the Works shall not be exposed to direct sunlight for more than 24 hours prior to being covered up by the pier protection material.

Geotextile fabrics arriving on the site in containers shall be unpacked and stored until usage in locations or in a manner well sheltered from the sun. Sufficient ventilation under the shelter shall be provided so as to minimize the effects of high temperature thermo-oxidation.

38.3.8 Installation of Geotextiles

Geotextiles are required to provide an underlayer to the MP2 pier protection. The underlayer separates the pier protection from the foundation material, allowing the passage of water but resisting movement of the fine soils which make up the bed and banks of the river.

The geotextiles shall be installed as described in this Specification, in the positions and to the lines and levels shown on the Drawings.

The method of installation shall not impose stresses or strains likely to cause damage to the geotextile. In this context, damage shall mean significant change in the specified properties, and/or puncturing or tearing of the fabric. The geotextile shall be free of folds and creases after placing.

The method of installation shall ensure that the geotextile is in continuous contact with the surface on which it is placed, without stretching or bridging over humps or hollows. This requirement establishes the dredged surface tolerances referred in Clause 38.1.5. Construction plant must not operate directly on a geotextile.

When the pier protection material is being placed on the geotextile, it must be done in such a manner as to avoid the risk of the fabric being punctured or the overlaps being displaced. In particular, the Contractor shall limit the height from which concrete blocks are dropped onto the geotextile. For concrete blocks dropped through water there shall be no restriction of the total drop, but the concrete blocks shall be released as close to the water surface as is practical for the type of plant utilized.

Concrete blocks shall be placed rather than dropped onto the geotextile.

In the case of geotextiles placed under water, the Contractor shall demonstrate to the satisfaction of the Engineer, that his method of placing shall achieve the quality of construction implied by this Specification. The use of underwater inspection techniques is expected to be employed in the construction. In particular the Contractor shall demonstrate to the Engineer that:

- minimum laps have been maintained;
- no rock gets placed between overlapping mattresses;
- the underside of the geotextile is in contact with the underlying material.

38.4 Concrete Blocks

38.4.1 General

Concrete for Concrete Block Pier Protection shall be Class 20/20 and shall conform to the requirements of Section 8 (Concrete Structures) of this Specification.

In addition, the Contractor shall comply with the following workmanship requirements:

- Concrete blocks shall have smooth finished surfaces and sharp edges. No plaster finishing will be accepted;
- The size of the concrete blocks shall not deviate from the each required size of 300 x 300 x 300 mm, 250 x 250 x 250 mm and 200 x 200 x 200 mm and each face shall be a perfect square;
- Handling of concrete blocks shall not be allowed before 7 days of curing.
- Casting of blocks may be done over another concrete block provided the lower block has been cured at least for 7 days and the two blocks are separated with suitable material, e.g. thick polythene etc.;
- Concrete blocks showing cracks, broken edges or honeycomb in the surface shall not be accepted;
- Concrete blocks containing protrusions, etc. shall not be accepted;
- Each block shall be marked with the date of casting.

38.4.2 Stock Piling

(a) The Contractor shall submit a detailed plan for stockpiling of concrete block within 45 days after receipt of the Commencement Date. Stockpiles may be located in the Contractor's own working area. Should the Contractor wish to stockpile concrete block at locations not forming part of the Site, then he shall make his own arrangements.

(b) The Contractor shall take all necessary steps to ensure that material of a stockpile shall not be contaminated or mixed with other materials.

(c) Any material dumped in a way not approved by the Engineer or spoiled as a result of the Contractor's operations shall be removed from the site by the Contractor immediately.

38.5 Working Records for Engineer's Inspection

The Contractor shall maintain records of all items of works executed in each day as follows in addition to his own working records:

a) Dredging

1. Operation of dredger in hours
2. Quantity of earth excavated, quantity of earth filled
3. Locations of dredging and filling including levels of the dredged and filled areas

b) Pier Protection Work

1. Number of concrete blocks manufactured
2. Area of concrete block pitching
3. Area, Volume and location of rip rap with dumped concrete block

c) Materials

1. Quantity of each type of materials arrived at Site and relevant stockpile locations.
2. Quantity of each type of material consumed in work.

The Contractor shall produce all these working records as and when required by the Engineer in addition to the weekly returns submitted by the Contractor in accordance with Article 0.5.3 of this Specification. The Engineer shall have access to all daily records of the Contractor for verification such as dredger log books, daily incoming and outgoing material register, weigh bridge records, daily operational roster of all plant and equipment, import invoices etc.

The Engineer shall have the right to be on board the dredger and other water based equipment and may request any of the working documents for the Engineer's inspection.

SECTION 39
HORTICULTURE

39 HORTICULTURE

39.1 Scope of Work

This work consists of the planting, protection and maintenance of plants, and the replacement of the dead, unhealthy, damaged or badly impaired plants to complete the works indicated on the Drawings in accordance with the requirements specified or referred to herein, all to the Engineer's satisfaction. The Contractor shall be required to submit the detailed method statement including plans and sketches to show relevant details for Engineer's approval sufficiently prior to the work commencement.

39.2 Materials

39.2.1 Filling Materials

Filling to make up the levels of the cultivated areas shall be basically subsoil, in accordance with SECTION - -: EXCAVATION AND BACKFILLING, but may contain an admixture of course sand, gravel and other small hard materials up to approximately 25% of the total bulk. Subsoil shall be free from an excessive portion of lime, any lump of clay, rubbish, ash, clinker, concrete, weeds, roots, and couch grass and like.

39.2.2 Topsoil

a) Topsoil for the cultivated areas, tree pits and plant boxes shall be of a good quality medium top soil, loam, easily cultivated when moist but not very sticky and not leaving a smooth surface when smeared.

b) It shall be free from subsoil, chemical and other pollution, obnoxious weeds, roots, turf, couch grass, rubbish, or an excessive proportion of clay, sand gravel chalk or lime. Also it shall not contain stones or flints in quantities exceeding 10% of the total bulk and those presents shall not exceed 20 mm in any dimension.

c) Where the topsoil is to be imported, The Contractor shall submit a sample load, as required by the Engineer, for approval and shall ensure that all subsequent deliveries are similar to the sample load.

d) Organic materials from sewage work shall not be used as soil substitute.

39.2.3 Plants

a) Plants shall have a habit of growth that is normal for the species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases and injuries. The plants shall consist of trees, shrubs, ground covers, and grasses of species locally available or from an alternative source approved by the Engineer. The tree seedlings shall be obtained by the Contractor from the District Forest Officer of the Forest Department of the Ministry concerning closest to the Works or, if not available, from an approved alternative source. The plants shall include such as Areca palm, Hibiscus, etc. as indicated or shown on the Drawings.

b) All plants shall be not less than the nominal height specified in the following list, which are the minimum acceptable sizes for each type of plant:

Type of Plant	Nominal height (cm)
1. Trees (Palms)	300 - 400
2. Shrubs	50 - 70
3. Ground Covers	10 - 30
4. Grasses	3

Detailed dimensions such as Plant height, trunk diameter, trunk height, etc. are shown on the drawings.

c) The plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at the time of planting, especially for some trees.

39.2.4 Staking And Guying Materials

a) Stakes/support of tree shall be of bamboo or woods.

b) Rope for guying shall be plastic tape.

39.3 Construction Requirements

39.3.1 General

The contractor shall employ qualified and experienced horticulturalist who shall be responsible for the Works, assisted by properly trained and experienced gardeners, who shall be solely engaged on the Works specified in this Section.

The Contractor shall submit for approval the curriculum vitae of the horticulturalist sufficiently prior to the Works commencement.

39.3.2 Preparation Work

a) Over all the area disturbed by cuts and fills, the surface shall be cleaned of sticks, stones, roots and debris, cultivated to a minimum depth of 10cm, dragged and spread to an even surface, ready for top soiling.

b) After the sub grade has been cleaned, topsoil materials shall be spread evenly thereon and lightly compacted. Topsoil thickness shall be 15cm maximum.

c) No topsoil shall be spread in muddy condition. Topsoil material shall consist of 70% of fertile soil and 30% of fertilizer, in accordance with Section __: FERTILIZING.

d) Sodding shall conform to SECTION __: SODDIGNG

e) The Contractor shall provide adequate and suitable protection against water to the satisfaction of the Engineer, so that no water will stagnant and damage the Works.

f) Before planting, plant root balls or containers shall be thoroughly soaked until no rising of air bubbles takes place. All wrapping around roots and containers shall be removed before planting. The plants shall be placed at locations shown on the Drawings, or as directed by the Engineer.

39.3.3 Planting

a) General

Planting shall be started, after all Civil Works and Buildings have been completed and the Contractor has received a written-permission from the Engineer.

b) Trees, shrubs and Ground Covers

i) Planting shall be carried out as indicated on the Drawings, and the Engineer shall approve any necessary adjustments.

ii) Planting pits or excavation shall be as follows:

- Pits for trees shall be 80cm x 80cm and 80cm deep,
- Pits for shrubs shall be 40cm x 40cm and 40cm deep, and
- Excavation for ground covering shall be 10cm deep.

iii) All plants shall be planted in pits; a week after the pit is prepared. Roots shall be spread in their normal position and all broken or frayed roots shall be cut off neatly. Filling material that is composed of 70% of suitable soil (ph.7) and 30% of manure/ fertilizer shall be placed and compacted carefully to avoid injury to roots and to fill all voids. When the hole is nearly filled, water shall be added as necessary and allowed to soak away.

iv) Trees shall be supported immediately after the planting operations and stakes for supporting the trees shall be equally spaced around each tree and the creosoted end shall be driven vertically into the ground to a depth of 60cm in such a manner as not to injure the ball or roots. The length of the bamboo or wood stakes shall be not less than 180cm.

v) Area surrounding the planting pit shall be excavated to a depth of 4cm for watering.

vi) Trees with thick leaves shall be trimmed to prevent an excessive loss of water.

c) Grasses

i) Grass shall be planted after the planting of trees, shrubs and ground covers has been completed.

ii) Planting of grass shall conform to SODDING.

39.3.4 Maintenance

a) Maintenance shall begin immediately after the completion of the planting operations and shall continue in accordance with the requirements specified herein below.

b) The plants shall be protected and maintained by watering, trimming and replanting as necessary for at least 60 days and as long as is necessary to establish a uniform stand of the specified plants until acceptance.

c) A weed killer or other poisonous material, which may cause damage to the plants, shall not be used. Insecticide and fungicide shall be proprietary products approved by the Engineer.

d) Watering shall be done two times a day in the dry season and once during the monsoon season and shall not be carried out between the hours of 9:00 a.m. and 4:00 p.m.

e) New plants shall be protected and maintained until the end of the grass planting maintenance period or, if installed after the grass planting maintenance period has elapsed, it shall not be done so until planting process is completed. Maintenance shall

include cultivating, mulching, tightening and repairing of guys/rope, removal of damaged material, resetting plants to the proper grades or upright position and restoration of the planting saucer, and all other necessary operations. Any protection works that the Engineer deems necessary to protect the plants from damage, uprooting or death shall be provided for at the Contractor's expense.

39.3.5 Guarantee and Replacement

a) Guarantee

Plants shall be guaranteed for a minimum period of 6 (six) months or for the duration of one full growing season and shall be alive and in a satisfactory growth condition at the end of the guarantee period.

b) Replacement

i) The contractor shall be responsible for the plants if found to be dead, damaged, or in an unhealthy or badly impaired condition, which shall then be replaced within three days after a site instruction has been issued by the Engineer to the Contractor. All plants to be so replaced as instructed by the Engineer shall be planted by the Contractor prior to the issuance of a completion Certificate for the Works or any part thereof.

ii) At the end of the guarantee period, the Engineer upon receiving a written notice, requesting such inspection, submitted by the Contractor at least ten days before the anticipated date, shall make an inspection. In case of any query regarding the condition and satisfactory establishment of the rejected plants, the contractor may opt for allowing such plant to remain through another complete growing season and after this time the rejected plant if found to be dead, in an unhealthy or badly impaired condition, shall then be replaced.

39.4 Sodding

39.4.1 Description

This work shall consist of furnishing strip sods as required and planting them to give a healthy, stable covering of grass which will maintain its growth in any weather and prevent erosion of the material in which is planted.

39.4.2 Material

Grass shall be of species native to southern region of Bangladesh, harmless and inoffensive to people and animals and not of kind recognized as nuisance to agriculture; shall be rapid spreading; free of disease and noxious weeds; and shall be deep rooted. The Contractor shall notify the engineer not less than 3 days before cutting of sods begins. The Engineer will approve the source of sods before cutting and delivery to the Project.

Sods shall be planted with their root system substantially undamaged and cut into blocks with moist earth in which they have grown. Sods should be laid within 5 days of cutting.

Sod blocks shall be hauled and stored in such manner that they will be protected from direct sunrays, provided with air circulation, and prevented against drying.

39.4.3 Construction

Surfaces on which sod blocks are to be placed shall be scarified and shaped after removing debris, gravel, and weeds.

The surfaces below the sods shall be made up as necessary with good quality topsoil so as to ensure that the sod and topsoil together form a finished thickness of 25cm. The Contractor will be responsible for ensuring a healthy growth in sodden areas and necessary fertilizer used before or after sodding will be at his own expense.

Sod blocks shall be placed so as to cover 50% of the surface by forming sod strips at the interval of 30 cm (this will be called " Strip sodding"), or as to cover entire surfaces (which shall be called "solid sodding"), as noted in the Drawings or directed by the Engineer. In either case joints shall be staggered to form a broken bond and joints between adjacent sod blocks shall not exceed 1 cm. Sod blocks shall be placed in smooth finish and compacted by a roller of 100 kg weight or by tamper plate.

Sufficient bamboo stakes shall be used to prevent the sod blocks slipping when sodding are provided on slopes. Topsoil shall be uniformly spread between sods to provide a smooth surface and the entire surface sprinkled lightly with water free from objectionable impurities.

For at least six months after completion of sodding, the Contractor shall maintain watering and other incidental operations. Sodden areas will subject to special checks, 2 and 12 months after they have been laid. Any areas in which sods are not maintaining a healthy growth shall be refurnished and re-sodded by the Contractor at his own expense.

The Contractor will be responsible for cutting and keeping clean all sodded areas until issue of the Provisional Handover Certificate.