TENDER DOCUMENT

FOR

NIT NO: DLI/CON/NKDA/413

Piling Works along with Performing Its Lateral and Vertical test pertaining to the Construction of first Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority at Plot No. DG/13, Premises No. 04 – 3333, Action Area – 1D, New Town Kolkata.

VOLUME – IIB

TECHNICAL SPECIFICATION

Drawings

(Bidders have to refer only relevant Technical Specifications / Drawings)
### TECHNICAL SPECIFICATIONS

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1.0.0 Introduction:
New Town Kolkata Development Authority intends to undertake the construction of First Phase (B+G+IV) of administrative Building of New Town Kolkata Development Authority in Premises No- 04-0333, Plot No- DG/13, AA-ID.
New Town Kolkata Development Authority is keen to develop their own office in the heart of this township which is eventually become a multiple/corporation office. The Authority has a dream that this multifunctional city will get a unique landmark building as its office with good aesthetics, which will enhance urbanscape. In addition to providing of office facilities along with Auditorium, Conference room & Cafeteria, the building will also have landscaping features like foundation, water bodies, terrace garden etc. Internal roads & pathway area lighting will be of standard with good architectural views. Within the project area there will also be security & management staff room.

1.0.1 Description of the Project:
- The project site is located at Premises no: 04-3333, DG-13, Action area-1D, New Town, Kolkata
- The area of the plot is approximately 7001.888 Sq.m.
- Total Built up Area is 14009.016 Sq.m The first phase built up area is 9619.269 Sq.m.
- Proposed FAR to be consumed is 2.001. The first phase FAR will be 1.37
- Proposed Ground Coverage is 19.71%.

1.0.2 Scope of Work:
The major buildings/ spaces to be covered (with all services) under design scope are as follows:

A. Buildings/ Structures:
- a) Reception lounge.
- b) Workstations.
- c) Conference room.
- d) Bank facilities.
- e) Auditorium
- f) Archive.
- g) Cafeteria
- h) Gymnasium.
- i) Kitchen and pantry.
- j) Toilet Block (Ladies & Gents)
- k) Security & Manager’s Office
- l) Security Block
- m) Electrical Substation
n) Pump room.
o) UG & OH water tank

B. **Outdoor Areas:**
   a) Boundary Wall & Gate
   b) Roads, & Pathways
   c) Grass paver / Green Areas
   d) Planter box
   e) Fountains
   f) Water bodies
   g) Outdoor Illumination & DG
   h) Infrastructural Services

The scope of services include construction of the above with site grardening and landscaping as well as all infrastructural facilities like water supply, sanitary & plumbing, electrical, fire detection & fire fighting, auditorium-related services like acoustics, stagecraft & stage lighting.

1.0.3 **Architectural specifications:**

In external wall Exterior grade acrylic paint with high heat reflective index will be used. Structural glazing, ACP cladding and louvers will be used as per architectural drawings.

1) **Reception Lounge/ Entry lobby:**
   a) **Flooring:** Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) **Internal Wall:** Decorative wall tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).
   c) **Skirting:** Same as flooring
   d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.
   e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.
   f) **Roof:** Flat roof.

2) **Workstations:**
   a) **Flooring:** Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) **Internal Wall:** Acrylic emulsion paint over wall putty.
   c) **Skirting:** Same as flooring
   d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in
position Fibre Cement Design board as detailed in technical specification.

e) **Door & Window**: Aluminum framed window with all structural glazing and wooden flush doors.

f) **Roof**: Flat roof.

3) **Executive Offices**:

a) **Flooring**: IPS flooring over which a PVC flooring (with wooden finish appearance) has to be lain.

b) **Internal Wall**: Decorative wall paper/Textured paint (Fine/Super fine)

c) **Skirting**: Same as flooring

d) **Ceiling**: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) **Door & Window**: Aluminum framed window with glazing/structural glazing and wooden flush doors.

f) **Roof**: Flat roof.

4) **Conference Room**:

a) **Flooring**: IPS flooring over which a laminated teak finish has to be lain.

a) **Internal Wall**: Decorative wall paper/Textured paint (Fine/Super fine)

b) **Skirting**: Same as flooring

c) **Ceiling**: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

d) **Door & Window**: Aluminum framed window with structural glazing and wooden flush doors.

e) **Roof**: Flat roof.

5) **Bank**:

a) **Flooring**: Uneven non-skid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).

b) **Internal Wall**: Acrylic emulsion paint over wall putty.

c) **Skirting**: Same as flooring

d) **Ceiling**: False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

e) **Door & Window**: Aluminum framed window with all structural glazing and wooden flush doors.

f) **Roof**: Flat roof.

6) **Archive/Library**:

a) **Flooring**: Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
b) **Internal Wall:** Acrylic emulsion paint over wall putty.

  c) **Skirting:** Same as flooring

  d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position 6mm thick high pressure steam cured non-asbestos fiber cement ceiling board.

  e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

  f) **Roof:** Flat roof.

7) **Cafeteria:**

   a) **Flooring:** Uneven nonskid tiles of approved brand size not less than 600 x 600 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).

   b) **Internal Wall:** Acrylic emulsion paint over wall putty.

   c) **Skirting:** Same as flooring

   d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

   e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

   f) **Roof:** Flat roof.

8) **Gymnasium:**

   a) **Flooring:** 8mm thk. PVC (Wooden Finish) floors over 25 mm. thk. P.C.C.

   b) **Internal Wall:** Acrylic emulsion paint over wall putty.

   c) **Skirting:** Same as flooring

   d) **Ceiling:** False ceiling with concealed metal (G.I.) frame work; providing & fixing in position Fibre Cement Design board as detailed in technical specification.

   e) **Door & Window:** The main exit doors will be fire doors as per specification for 2hr. fire rating. Other doors will be wooden framed and paneled polished door.

   f) **Roof:** Flat roof.

9) **Kitchen & Pantry:**

   a) **Flooring:** 1st quality ceramic tiles (non skid) laid on 20 mm thick screed in cm. (1:4) over RCC slab. In case of sunken floor sub base of P.C.C.(1:2:4) over cinder filling will be adopted before laying of ceramic tiles with screed in cm.

   b) **Internal Wall:** Ceramic tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).

   c) **Skirting:** Same as flooring

   d) **Ceiling:** Acrylic emulation paint over wall putty.

   e) **Door & Window:** Aluminum framed window with glazing and wooden flush doors.

   f) **Roof:** Flat roof.
10) Toilet block:
   a) Flooring: 1st quality ceramic tiles (non skid) laid on 20 mm thick screed in cm. (1:4) over RCC slab. In case of sunken floor sub base of P.C.C. over cinder filling will be adopted before laying of ceramic tiles with screed in cm.
   b) Internal Wall: Ceramic tiles of approved brand laid over 20 mm thick screed in C.M. (1:4).
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.
   e) Door & Window: P.V.C. doors.
   f) Roof: Flat roof.

11) Managers room, Service areas:
   a) Flooring: Ceramic nonskid tiles of approved brand size not less than 400 x 400 x 10 mm thick laid over 20 mm thick screed in C.M. (1:4).
   b) Internal Wall: Acrylic emulsion paint over wall putty.
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.
   e) Door & Window: Aluminum framed window with glazing and wooden flush doors.
   f) Roof: Flat roof.

12) Staircase:
   a) Flooring: Green kota stone of 20-25 mm thick over 15 mm thick screed in cm (1:2) with white cement slurry and jointed with white cement slurry.
   b) Internal Wall: Acrylic emulsion paint over wall putty.
   c) Skirting: Same as flooring
   d) Ceiling: Acrylic emulation paint over wall putty.

13) Roof: Finish with Ceramic tiles.

14) Sanitary fixtures: White Ceramic

15) Sanitary Fittings: Brass

16) Grills & railing: Made of MS flats, MS square or MS pipes as per design

17) Stagecraft:
   a) Front Curtain: The front curtain should be double gathered guillotine type (upward rise) synthetic satin / velvet complete with front frills, electrical operating mechanism along with limit
switches. (to be approved by employer) fitted and fixed maintaining proper alignment with procenium opening.

b) **Box bar for batten & frill:** Box bar for batten & frill should be 62mm X 40mm Al. with 100mm dia. 1 way, 2 way, 3 way pulleys properly fixed on grid structures with 10mm dia polypropylene rope fully motorized (to be approved by employer) fitted and fixed maintaining a perfect horizontal position and connected to pulleys at grid and motor or as detected by engineer in charge/employer.

c) **Wing mechanism:** Wing mechanism made with cloth legs complete with traveling arrangement and 1.5m box and satin black markin cloth. (to be approved by employer) fitted and fixed maintaining at perfect horizontal position or as detected by engineer in charge/employer.

d) **Lighting bars:** Lighting bars should be made with 38 mm nb. medium MS black pipe along with motorized mechanism fully motorized fitted and fixed maintaining at perfect horizontal position and connected to pulleys at grid and motor or as detected by engineer in charge/employer.

e) **Frills:** Frills should be made of black markin cloth for masking (to be approved by employer) and properly fitted to frill bar as detected by engineer in charge/employer.

f) **Black curtain:** Black curtain should be complete with motorised mechanism and cloth (to be approved by employer) motorized fitted and fixed maintaining a perfect horizontal position and connected to pullys at grid and motor or as detected by engineer in charge/employer.

g) **Cyclorama screen:** Cyclorama screen should be complete with frame structure (usable for projection) (to be approved by employer) placed on stage as detected by engineer in charge / employer

h) **Grid structure:** The grid structure should be provided at stage top and catwalk with 50mm dia. MS black pipe/ rectangular section fitted from front to back over 40mm dia pipe/rectangular section held from the existing RCC structure and 50X50X6 MS angle & 25mm thick wooden gangway as detected by engineer in charge / employer.

i) **Stage flooring:** Stage flooring should be made of with 1800 X 150 X 40 mm seasoned hollock/gamar wood planks on 100 X 75mm teak wood runners complete with waxing. The teak wood runners should be properly fixed with the p.c.c. base of the stage. The seasoned hollock/gamar wood planks should be fixed on top of teak wood runners leaving some trap doors for power point as detected by engineer in charge / employer. The seasoned hollock/gamar wood planks will then be properly waxed to finish.

j) **Projector:** A top mounted EPSON or equivalent make ultra-bright, large-venue projector for film projection (to be approved by employer) with not less than White Light Output 10,000 lumens, Colour Light Output 10,000 lumens, XGA resolution, with arc correction, point correction facilities. Fitted and fixed from false ceiling or as directed by engineer in charge / employer.

**Acoustic treatment & auditorium interiors:**
Side walls will be treated with fully perforated Armstrong or Anutone make board of 12.5mm on GI frame with chicken mess wire backing with 25mm 16kg/m3 density glass wool (mid absorbent zone)
k) Front sidewall treatment up to 3m from the stage with ply board of 12.5mm on GI frame with polish. (Reflecting zone having 0.5 reflection)
l) Back wall treatment with fully perforated Armstrong or Anutone make board of 12.5mm on GI frame with chicken mess wire backing with 50mm 36kg/m3 density glass wool. (Extreme highly absorbent zone)
m) Side wall & black wall skirting treatment up to 5ft from the ground level with 12mm ply board on GI frame with decorative bit & polish.
n) Providing false ceiling with fine fissured mineral fibre Armstrong or Anutone make boards in GI grid for main ceiling.
o) Providing heavy drapery on doors & windows

Notes.
Everything should follow the drawings & design strictly as much as possible

Executive Engineer-I
New Town Kolkata Development Authority
SECTION-B

TECHNICAL SPECIFICATION FOR ARCHITECTURE, CIVIL, SANITARY AND PLUMBING WORKS

Unless otherwise stated in the schedule of works or detailed specifications as enumerated in this volume of the tender document, all specifications, items of works, mode of measurements etc. for civil works should be as per the current PWD (West Bengal) Schedule of Rates for Building, Sanitary and Plumbing and other Works. The detailed specifications as elucidated in this section should follow the provisions pertaining to specifications, items of works, mode of measurements etc. as stipulated in current PWD (West Bengal) Schedule of Rates. The specification for works not covered PWD (WB) Schedules, DSR or Schedule of MES,CPWD shall be followed. Items of Works not covered in the above schedules should be governed by I.S.I code of Practice, National Building Code, technical specifications as laid in this tender document, and as per best practice according to the Engineer-in-Charge and the Consultant.

1. EARTH WORK

1.1 SCOPE OF WORK

The works covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with earthworks of all underground supplies and services and for all structural units, stock piling, of specifications and applicable drawings, and subject to terms and conditions of the contract. The scope of this section of specifications is also covered with detailed specifications as laid down herein.

1.2. GENERAL CONSIDERATIONS

1.2.1. The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil, which might be encountered during excavation of earthworks. The Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the report, drawings or in any other contract documents or to material obtained from boring or trail holes. The contractor shall be deemed to have made local and independent inquiries and shall take the whole risk of the nature of the ground subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.
1.2.2. All excavations, cutting, and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the period of maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the period of maintenance any damage or defects in cuttings and fills, structures and other works, caused by slips, falls or basins or any other ground movement due to the Contractor's negligence shall be made good by the Contractor at his own cost.

1.2.3 Before excavation is started, the area coming under cutting / excavation shall be thoroughly grubbed and cleared off shrubs, vegetation, grass, bush wood, debris, trees / sapling of girth upto 300 mm. The roots shall be removed upto depth of 600 mm below ground. The rubbish shall be removed outside the site as directed by the Engineer-in-charge.

1.3. APPLICABLE CODES

The following Codes shall be followed:

1.3.2. IS: 1498-1970 Classification and identification of soils for general engineering purposes.
1.3.3. British Standard 1377-Methods of test for Soils for Civil Engineering Purposes.
1.3.4. British Standard 5930- Code of Practice for Site Investigations.
1.3.5. IS: 1200 for method of measurement of building works.( Item for Excavation and Earth Work .The Item shall be measured as per plan area of PCC, working space shall not be taken into measurement, deemed to be included into rates)

1.3.6. Local Building Regulations and Statutory Regulations.

1.4. SITE PREPERATIONS

1.4.1. The Contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall, at his own expense, rectify such error, to the satisfaction of the Engineer-in-charge. The Contractor shall construct and maintain accurate benchmarks so that the engineer-in-charge can easily check the lines and levels.

1.4.2. The Contractor shall Construct and maintain such ditches, in addition to those shown on the plans, as will adequately facilitate drainage of areas under construction.

1.4.3. The Contractor shall perform a joint survey with the Engineer-in-charge's representative of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from him before starting the earthwork.

1.5. DETAILED METHODOLOGY

1.5.1. EXCAVATIONS

1.5.1.1. Excavation shall include the removal of all material of every name and nature. Excavations shall be carried out in accordance with excavation plans and sections shown on the Drawings and as directed by the engineer-in-charge.
1.5.1.2. The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as per drawings or as directed by the engineer-in-charge. The excavation, which cannot be done by mechanical means including leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and back fill shall be stock piled within the free haulage limit of the boundary of the works.

1.5.1.3. The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the engineer-in-charge full details of his proposals. The engineer-in-charge may require modifications to be made if he considers the Contractor's proposals to be unsatisfactory and the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

1.5.1.4. For major excavations, the Contractor shall submit for the prior approval of the engineer-in-charge full details and drawings showing the proposed method of supporting and strutting etc. The design, provisions construction, maintenance, and removal of such works shall be the responsibility of the Contractor and all cost in these respects shall be included in his quote.

1.5.1.5. The Contractor's attention is drawn particularly to his obligations under the general conditions in respect of those works which are in close proximity to existing buildings.

1.5.1.6. The Contractor shall preserve the complete excavation from damage from slips and earth movements, ingress of water from any source what so ever and deterioration by exposure to the sun and the effects of the weather.

1.5.1.7. All excavation of every description, in whatever material encountered shall be performed to the elevations and dimensions shown on the drawings in such a manner as to avoid interruption to work in other parts of the site. The Contractor shall be responsible for injury to the permanent works caused by excavation on other parts of the works.

1.5.1.8. Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

1.5.1.9. All excavations in foundations shall be taken to 150mm and shall be trimmed carefully to a smooth and level surface, immediately after trimming to the final elevation a layer of building concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted and covered by concrete by the end of the day. It is specifically brought to the notice of the Contractor that any excavation taken down to the trimmed elevation which is left overnight or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the engineer-in-charge and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the Contractor.

1.5.1.10. No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the engineer-in-charge and his permission to proceed given.

1.5.1.11. If excavation for sub-structures is carried below the required level, as shown in the drawings or as directed by the engineer-in-charge, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.

1.5.1.12. All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and
the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any corrosion due to undercutting from underneath the previously constructed adjoining foundations.

1.5.1.13. Shoring, where required during excavation, shall be installed to protect the bank, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of the engineer-in-charge, for upholding the sides of excavation and also for planking and strutting to excavation against the side of roadways and adjoining properties in existing hardcore of any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect.

1.5.1.14. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be required to be repaired by the Contractor at his expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the engineer-in-charge. When utility lines which are to be removed, are encountered within the area of operations the Contractor shall notify the engineer-in-charge in ample time for necessary measures to be taken to prevent interruption of the service.

1.5.1.15. Excavated material suitable for use as filling material shall be stock piled within the free haulage limit to 100m from site of works as directed by the engineer-in-charge. This stock piled material shall be transported back to places requiring fill or backfill. Surplus or material unsuitable for use as filling shall be disposed of by the Contractor at locations approved by the engineer-in-charge within specified haulage limit of 8 Kms.

1.5.1.16. The excavation work shall include excavation in above water table and excavations below water table. The Contractor shall submit the proposal for dewatering from the areas of excavation for the approval of Engineer and shall provide all plant, equipment, pumps, sheeting, and well points as required to keep the water table below 1.0m from the deepest foundation as shown on the drawings till the completion of foundation works.

1.5.1.17. The Contractor shall make independent inquiries and perform and make independent observations to ascertain the water table in the areas of excavations during the period when the construction works are in progress. The Contractor shall take whole risk of any nature for fluctuation of the water table from his own findings. The Employer is not bound in any way and shall not be responsible for any information given by him or any information, observations or values obtained from his reports, drawings and documents.

1.5.1.18. Excavation for pits, cable trenches and equipment foundation and other structures shall be taken out to the levels and dimensions as the engineer-in-charge may direct.

1.5.1.19. Before starting the excavations, the Contractor shall ensure the correct alignment of the pipe line on the ground, the depth and width of excavation of the trench, all in accordance with the drawings and instructions of the engineer-in-charge. The Contractor shall make profiles with cement concrete pillars.

1.5.1.20. Excavation shall be carried out true to line, grade and width as shown on the drawings or as directed by the engineer-in-charge ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenant and any other structures. The trench bottom shall be graded to provide even and substantial bearing.

1.5.1.21. The Contractor at his cost shall provide to the satisfaction of the engineer-in-charge all timbering, approved supports and shores and bracings to the sides of the excavated trench and foundations in such a manner to secure the sides of the trench and excavations from falling or adverse
movement. All responsibility connected with such shoring shall rest with the Contractor. Adequate clearance / working space on both sides of the structure/pipe line shall be provided for which no payment shall be made.

1.5.1.22. Without the written permission of the Engineer-in-charge no more than 50.0m the trench shall be opened in advance of the completed pipeline.

1.5.1.23. The bottom of all excavations shall be carefully leveled. Any pockets of soft or loose material in the bottom of the pits and trenches shall be removed and the cavities so formed filled with lean concrete at the Contractor's expense.

1.5.1.24 The engineer-in-charge may require the Contractor to excavate below the elevations shown on the drawings or he may order him to step above the elevations shown depending upon the suitable foundation material encountered.

1.5.1.25 If for any reasons, the levels grades or profiles of the excavations are changed adversely, the Contractor shall at his own cost be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the engineer-in-charge.

1.5.1.26 Dewatering
The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Engineer-in-charge, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Engineer-in-charge to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved be the Engineer-in-charge. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Engineer-in-charge obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

1.5.1.27 Timbering / Planking and Strutting

When the depth of a trench in a soft but firm soil exceeds 1.5 mtr., stepping, sloping, and or planking and strutting of side shall be done as order in writing by Engineer-in-charge. In case of loose and slushy soil / sandy soil, the depth at which these precaution are to be taken shall be determined by Engineer-in-charge according to the nature of soil.

It shall be the responsibility of the contractor who shall take all necessary steps to prevent the side of trenches from collapse. Regarding the necessity or otherwise of timbering or any other safety measure, the contractor shall be responsible to obtain the decision of the Engineer-in-charge, in writing, failing
which the contractor shall be liable for any damage for due to non adoption of proper timbering for other safety measure.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut. If however, Engineer-in-charge directs any timbering to be left-in, keeping in mind the type of construction or any other factor, Contractor shall be paid for at the scheduled item rate for such left-in timbering.

Unless otherwise separately provided for in Schedule of Quantities, the timber shoring is deemed to have been included in the unit rates quoted for excavation. If separately provided for, then the actual effective area of shored faces as approved by Engineer-in-charge shall be measured in sq. mtrs. The area of planking embedded in the bed/sides of excavation will not be considered, nor the area supporting inclined struts in case of large pits/open excavation. All planks, boards, wallings, verticals, struts, props and all other materials required for shoring and subsequent safe dismantling and removal shall be included in the quoted unit rates.

1.5.2. EXCAVATION TOLERANCES

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings. Where no tolerance limits are indicated excavation shall be performed to tolerances established by the engineer-in-charge as accepted for the design and type of work involved.

1.5.3. BACKFILLING

1.5.3.1 After completion of foundation footing, foundation, walls, and other construction below the elevation of the final grades and prior to backfilling, forms shall be removed and the excavation shall be cleaned of trash and debris.

1.5.3.2 The backfilling shall include filling under the floors, around the foundations, trenches, pipes, conduits, ducts and channels and bedding for pipes.

1.5.3.3 The backfilling work shall include loading, unloading, transporting, placing, stocking, spreading of earth, watering, rolling, ramming and compacting complete as specified herein.

1.5.3.4 Filling shall be approved selected material from excavation or other predominantly granular material and free from slurry, mud, organic or other unsuitable matter and capable for compaction by ordinary means.

1.5.3.5 The excavated material if found suitable shall be stock piled within the free haulage limit of the site of the works. This material shall be used for backfilling if approved by the engineer-in-charge and shall be transported by the Contractor anywhere required for the purpose of backfilling work in this contract.

1.5.3.6 The Contractor shall provide the approved quality fill and backfilling material as required to complete the fill/backfilling work.

1.5.3.7 Filling in trenches and foundation shall be placed in 150 mm layers and compacted at optimum moisture content by mechanical means or other means as approved by the engineer-in-charge.

1.5.3.8 Fill in around pipes and cables shall be carefully placed with fine material to cover the pipe or cable completely before the normal in filling is done.
1.5.3.9 Material for back filling shall be as approved by the Engineer-in-charge and shall be placed in layers of 150 mm measured as compacted material and saturated with sufficient water and compacted to produce in-situ density not less than 95% of the maximum density at optimum moisture content, achieved in Test No.15 of BS 1377:1975 or similar clause of relevant IS Code.

1.5.3.10. All filled areas shall be left neat, smooth and well compacted with the top surface consisting of the normal site surface soil unless otherwise directed.

1.5.3.11. Depending on the depth of fill the engineer-in-charge may instruct increased thickness of successive layer to be placed.

1.5.3.12. Fill shall not be placed against foundation walls prior to approval by the engineer-in-charge. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

1.5.3.13. In case the Contractor is instructed to arrange for the fill material the quality of the fill material will be subject to the approval of the engineer-in-charge. The engineer-in-charge may require the Contractor to carry out various tests of the fill material. All such tests shall be made at an approved laboratory at the cost of the Contractor. Once a material from a specific source has been approved, the material for the same quality and from that source only shall be used. Any fill material from borrow pits which has not been approved or the quality of which differs from the approved material shall be rejected outright. The engineer-in-charge reserves the right to order removal of any such materials brought to the site of works at his discretion at Contractor's expense. In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.

1.5.3.14. The method of compaction, namely type of compactor, type of roller, weight of roller and number of passes proposed by the Contractor for any particular fill material shall be subject to the approval of the engineer-in-charge after completion of satisfactory field tests, subsequent to the laboratory analyses, using the materials and equipment proposed to be used for the earth work in conditions similar to those likely to be encountered during construction. The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at Contractor's expense.

1.5.3.15. Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the engineer-in-charge. Adequate control of the fill and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one hundred square meters of area compacted. The frequency of tests shall be determined on site and may be varied at the discretion of the engineer-in-charge. Compaction shall not be less than 95% in-situ density with respect to the maximum density, at optimum moisture content.

1.5.3.16. The exact thickness of layers and the method of placing and compacting the fill shall be determined by the field tests, as stated above, but notwithstanding the results of these trails, fill shall not be placed in layers exceeding 150 mm in thickness. In order to maintain control of the thickness of layers, timber profiles shall be used wherever feasible. The travelers of such profiles for each layer of fill shall be checked by the supervisory staff of the engineer-in-charge. The Contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The engineer-in-charge may forbid the Contractor to proceed with placing and/or compaction of fill and/or order removal and re-compaction of such fill when he finds that the Contractor has insufficient or defective equipment or that the fill has been improperly laid and/or compacted.
1.5.3.17. If it is found necessary to alter the moisture content of the fill material in any way, then very strict control shall be exercised over the wetting and/or the drying process and frequent moisture content tests.

1.5.3.18. The fill material should be well graded non-cohesive and nearly silt-free (silt content between 5 to 10 percent) salt free and free of organic materials (less than 2%). It should also be free of stones. It should be of such nature and characteristics that it can be compacted to the specified densities in reasonable length of time. It shall be free of plastic clays, of all materials subject to decay, decomposition or dissolution and or cinder or other material which corrode piping and other metals.

**SAND**
Sand shall be clean and free from dust, organic and foreign matter and corresponding to grading Zone V or IV, meeting the approval of the Engineer.

**MOORUM**
Moorum shall be of approved quality and shall be brought from approved source.

**FILLING WITH SAND**
At places where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours and drained to ensure maximum hydraulic compaction. Any temporary work required to contain sand under flooded condition shall be on Contractor’s account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer-in-charge has inspected and approved the fill.

1.5.4. **TOLERANCES**

The stabilization of compacted backfill/fill surfaces shall be smooth and even and shall not vary more than 100mm in 3 meters from true profile and shall not be more than 12.5mm from true elevation.

1.5.5. **DISPOSAL OF SURPLUS MATERIAL**

1.5.5.1. The rejected unsuitable material and surplus excavated material shall be disposed of beyond the compound in conformity with the municipal / corporation , rules for such disposal, loading into truck and cleaning the site in all as directed by the engineer-in-charge.

1.5.5.2. The disposal of surplus excavated material shall include loading, unloading, transporting, stacking, spreading as directed by the engineer-in-charge.

1.5.5.3. All excavated material not so used shall only be disposed of in areas identified by the Contractor approved by the engineer-in-charge. Such areas will be well drained and the deposited material left in a tidy and stable condition subject to approval of E-I-C.

1.6. **ROUTINE TESTS**

1.6.1. **Testing of fill materials:**

1.6.1.1. Tests shall have to be executed by an independent testing agency at the cost of the agency if desired by E-I-C.
1.6.1.2. Tests should comply with the following IS Standards.
1.6.1.3. Sampling
1.6.1.4. Sample preparation
1.6.1.5. Sieve analysis
1.6.1.6. Liquid limits
1.6.1.7. Plastic limit and plasticity index
1.6.1.8. Moisture content
1.6.1.9. Moisture density relationship
1.6.1.10. Sand equivalent
1.6.1.11. Specific gravity
1.6.1.12. Sand core density
1.6.1.13. Rubber balloon density
1.6.1.14. Classification
1.6.1.15. Carry out moisture density tests on representative samples prior to placing.
1.6.1.16. Carry out gradation of materials prior to placing as the work proceeds.
1.6.1.17. Carry out site density tests of materials as the work proceeds and as follows:

1.6.2. FREQUENCY OF TESTS
1.6.2.1. One test for each 500 Cum. placed for structural fill and 3000 Cum for general fill.
1.6.2.2. One test whenever there is a change of gradation or placement conditions.
1.6.2.3. Execute site density tests for compaction at a minimum depth of 100 mm below compacted surface.
1.6.2.4. Execute a gradation test with each site density test and whenever there is an apparent change in material being placed.
1.6.2.5. Execute the following site density tests and laboratory moisture density tests to evaluate compaction achieved:
One test for every 200-400 cu.m. of backfill in trenches or surrounding structures. One test for every full shift of compaction operations on mass earthwork.

1.7. MODES OF MEASUREMENTS

1.7.1. GENERAL

Except otherwise specified herein or elsewhere in the Contract documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the bill of quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the bill of quantities.

1.7.1.1 Dewatering, where required, to keep the foundation trenches dry during construction of works.
1.7.1.2 Timber shoring, planking, strutting and providing slope for up-holding the sides of excavations.
1.7.1.3 Any fill with approved material necessitated because of over excavation due to fault or negligence of the Contractor.
1.7.1.4 Stock piling of the excavated material at approved locations with 300m free haulage limit and transporting back suitable material to places requiring fill or backfill.
1.7.1.5 Specified foundation bed preparation.
1.7.1.6 Excavation involved in providing sufficient working space around sides of foundation and service line trenches.
1.7.1.7 Providing approved quality fill/backfill material from outside sources. Royalty for borrow areas and haulage of material shall not be paid for separately.
1.7.1.8 Rolling, leveling, watering and compacting the fill and backfill to required density.
1.7.1.9 All laboratory and field tests stipulated in these specifications.
1.7.1.10. Disposal of rejected unsuitable and surplus excavated material within 200m free haulage limit measured from the fence boundary of site of works following the shortest route as directed by the engineer-in-charge.

1.7.2 EXCAVATION

1.7.2. MEASUREMENT

Quantities of excavation shall be calculated / measured from the pre-work levels of natural ground taken jointly by the Contractor and the engineer-in-charge before commencement of the work.

The quantities set out for excavation and its subsequent disposal shall be deemed to be the bulk before excavating and no allowance shall be made for any subsequent variations in bulk or for any extra excavation unless otherwise shown on the drawings quantity of excavation shall be measured on the basis of vertical excavations required for the nominal concrete dimensions of the structural members of foundations. Lean concrete shall not be construed as structural concrete.

Quantities of excavation for service line trenches shall be measured for payment on the basis of vertical excavation faces for the specified width as shown on the drawings. Measurement for acceptably completed excavation works shall be made on the basis of number of cubic meter of material excavated for foundation and service trenches as shown on the drawings or as directed by the engineer-in-charge.

1.7.3. BACKFILL / FILLS

1.7.3. MEASUREMENT

Measurement for acceptable completed backfill/ fill works shall be made on the basis of number of cubic meter of compacted backfill/ fill in position, or as shown on the drawings or as directed by the ENGINEER-IN-CHARGE.

2. ANTI-TERMITE TREATMENT

2.1. GENERAL CONSIDERATIONS

2.1.1. All the buildings shall be adequately protected against attack by sub terrain termites by suitable chemical treatment measures. The work shall be carried out by a specialist pest control agency approved by engineer-in-charge. The work to be carried out by the specialist firm shall carry a guarantee for the satisfactory performance of the treatment for a min. Period of ten (10) years.

2.1.2. Prevention of termite from reaching the superstructure can be achieved by creating a chemical barrier between the ground and the building by treating the soil beneath the building and around the foundations. To have proper check for uniform, spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

2.2. APPLICABLE CODES

The Anti termite treatment shall be carried out generally in accordance with the stipulation laid down by the following:

IS 6313 (Part I) - Code of practice for anti termite measures in buildings Constructional Measures

IS 1200 (Part I) – Method of Measurement of buildings and civil engineering works
2.3. SITE PREPERATIONS

In order to ensure uniform distribution of the chemical emulsion and to assist penetration, the following site preparation shall be carried out:

2.3.1. Remove all trees, stumps, logs, or roots from the building site.

2.3.2. Remove all concrete formwork if left anywhere, leveling pegs, timber off cuts and other building debris from the area to be treated.

2.3.3. If the soil to be treated is sandy or porous, preliminary moistening will be required to fill capillary spaces in order to prevent the loss of emulsion through piping or excess percolation.

2.3.4. In the event of water logging of foundation, the water shall be pumped out before application of chemical emulsion and it should be applied only when the soil is absorbent.

2.3.5. Surface areas to receive the anti-termite treatment should be suitably leveled and compacted strictly in accordance with the manufacturers’ recommendations. All cutting, trenches and excavation should be completed with back filling in place. Borrowed fill must be free from organic debris and shall be well compacted. If this is not done, supplementary treatments should be made to complete the barrier.

2.4. MATERIAL SPECIFICATIONS

The earth filling immediately under the soling (under floors) bottom and side fills of all foundations (excepting foundations) and soil along external perimeter of all buildings shall be chemically treated against termites. The chemical to be used for the treatment shall be Dieldrin, Aldrin, Heptachlor or Chlordane or as specified conforming of the requirement and concentration lay down in IS 6313 (Part II) - latest edition.

MOUND TREATMENT
For a mound volume of about one cubic meter, four litres of an emulsion in water with 0.50 percent Chloropyrifos may be used.

SOIL TREATMENT
1.0 % of Chlorpyriphos emulsifiable concentrates (IS 8944) in water emulsion is effective when applied uniformly over the area.

2.5. DETAILED METHODOLOGY

2.5.1. TIME OF APPLICATION

Soil treatment shall start when foundation trenches and pits are ready to take mass concrete in foundations. Lying of mass concrete shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or when soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor.
2.5.2. DISTURBANCE

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.5.3. TREATMENT OF COLUMN-PITS, WALL-TRENCHES AND BASEMENT- TANKS EXCAVATION.

2.5.3.1. The bottom surface and the sides (up to a height of above 300 mm) of the excavation made for column pits, wall trenches and basements shall be treated with the chemical at the rate specified in IS 6313 (1981) Part II of 1981.

2.5.3.2. After the column foundations and the retaining wall of the basement come up, the backfill in immediate contact with the foundation structure shall be treated at the rate specified in IS 6313 of the vertical surface of the sub-structure for each side. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150mm centers close to the wall surface and spraying the chemical with the above dose. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surface is well treated with the chemicals.

2.5.3.3. In the case of R.C.C. framed structures with columns and plinth beams and R.C.C. basements/tanks with concrete mixes rich and dense (being 1:1.5:3 or richer), it is unnecessary to start the treatment from the bottom of excavation for columns and plinth beams. The treatment shall start at the depth of 500mm below ground level. From this depth the back-fill around the columns, beams and R.C.C basement wall shall be treated at the rate as per IS 6113 Part II. The other details of treatment shall be as laid down in the clause 3.6.2 above.

2.5.4. TREATMENT OF TOP SURFACE OF PLINTH FILLING

The top surface of the filled earth within plinth wall shall be treated with chemical emulsion at the rate as per IS 6313 Part II (surface area) before the sand/sub grade is laid. Holes up to 50 to 75mm deep at 150mm centers both ways shall be made with crowbars on the surface to facilitate saturation of the soil with chemical emulsion.

2.5.5. TREATMENT OF INNER WALL SURFACES

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, small channel 30 x 30mm shall be made at all the junctions of wall and columns with the floor (before laying the subgrade) and rod holes made in the channel up to ground level 150mm apart and the chemical emulsion poured along the channel as per rate of application, mentioned in IS 6113 Part II (1981) so as to soak the soil right up to bottom. The soil shall be tamped back into place after this operation.

2.5.6. TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING

During progress of work, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150mm and depth 300mm and filling these holes with chemical emulsion at the rate (as per IS 6313 Part II) per meter of perimeter of the external wall.

2.5.7. TREATMENT FOR EXPANSION JOINTS

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub-grade has been laid as per IS-6313 Part II of 1981. The soil beneath the expansion joints shall receive special attention when the treatment under 2.5.3 above is in progress. This treatment shall be supplemented by
treatment through the expansion joint after sub grade has been laid at the rate of 2 liters per meter length of the expansion joint.

2.6. WORKMANSHP

Only professionals with min. 5 years experience in this type of work shall be employed to carry out the anti-termite treatment required.

2.7. EQUIPMENT AND ACCESSORIES REQUIRED

To facilitate proper penetration of the chemical into the soil, a pressure pump of adequate capacity and sprayers shall be employed to apply the solution.

2.8. MODES OF MEASUREMENTS

The measurements shall be made in square meter on the basis of plinth area of the building at ground floor only for all operations described in schedule of quantities. Nothing extra shall be measured. The rate shall include cost of all material and labour involved in all operations described above.

2.9. SAFETY PRECAUTIONS

2.9.1. PRECAUTIONS DURING TREATMENT

2.9.1.1. Utmost care shall be taken to see that the chemical barrier is complete and continuous. Each part of the area shall receive the prescribed dosage of chemical emulsion

2.9.1.2. The treatment should not be carried out when it is raining or when the soil is wet with rain or sub soil water.

2.9.1.3. Once formed, the treated soil barrier shall not be disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.9.2. PRECAUTIONS FOR HEALTH HAZARDS AND SAFETY MEASURES

2.9.2.1. All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapors or spray mists or swallowed. Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below.

2.9.2.2. These chemicals are usually brought to site in the form of amplifiable concentrates. The containers should be clearly labeled and should be stored carefully so that children and pets cannot get at them. They should be kept securely closed.

2.9.2.3. Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they should be flushed with plenty of fresh water and immediate medical attention should be sought. The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed nearby during the mixing. Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs that serve as sources of drinking water.
2.10. GUARANTEE

2.10.1. On completion of the treatment in all respects, a guarantee that the building is safe from subterranean species of termite infestation for a period of 10 years is required on stamp paper in a format which shall be approved by the employer who shall have the final decision.

2.10.2. In the event of re-infestation of the said structure at any time during guarantee period, an undertaking is required to carry out such treatment as may be necessary to render the structure free from termite infestation without any extra cost including any remedial work, resulting sleeves, cutout etc.

3. CONCRETE WORK

3.1. SCOPE OF WORK

The work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials, and in performing all operations in connection with the supply and installation of plain and reinforced concrete work, complete in strict accordance with this section of the Specifications and relevant documents, subject to the Conditions of the Contract.

3.2. GENERAL CONSIDERATIONS

3.2.1. Full co-operation shall be given to other agencies, if any, to install embedded items and/or any associated services.

3.2.2. Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

3.2.3. Formwork shop drawings shall be designed and prepared by the Contractor at his own cost. Approval of shop drawings as well as those of mock-ups /actual samples of finished concrete shall be obtained before Work is commenced.

3.2.4. Contractor shall prepare BAR BENDING SCHEDULES, and get the same approved by the engineer-in-charge, prior to commencement of work.

3.3. APPLICABLE CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>IS - 299</td>
<td>Specification for Ordinary, rapid hardening and low heat Portland Cement</td>
</tr>
<tr>
<td>IS - 455</td>
<td>Specification for Portland blast furnace slag Cement</td>
</tr>
<tr>
<td>IS - 1489</td>
<td>Specification for Portland pozzolana Cement</td>
</tr>
<tr>
<td>IS - 4031</td>
<td>Method of physical tests for hydraulic Cement</td>
</tr>
<tr>
<td>IS - 650</td>
<td>Specification for Standard sand for testing of Cement</td>
</tr>
<tr>
<td>IS - 383</td>
<td>Specification for Coarse and Fine aggregate for use in mass concrete</td>
</tr>
<tr>
<td>IS - 515</td>
<td>Specification for natural and manufactured aggregate for use in mass concrete.</td>
</tr>
<tr>
<td>IS - 2387</td>
<td>Method of test for aggregates for concrete.</td>
</tr>
</tbody>
</table>
IS  - 516  Methods of test for strength of concrete.
IS  - 1199  Methods of sampling and analysis of concrete
IS  - 3025  Methods of sampling and test (physical and chemical) for water used in industry.
IS  - 2645  Specification for integral cement water proofing compounds
IS  - 1791  Specification for batch type concrete mixers
IS  - 2438  Specification for roller pan mixer
IS  - 2505  Specification for concrete vibrators, immersion type
IS  - 2506  Specification for screed board concrete vibrator
IS  - 2514  Specification for concrete vibrating tables
IS  - 3344  Specification for pan vibrators
IS  - 4656  Specification for form vibrators
IS  - 2722  Specification for portable swing weigh batchers for concrete (single & double bucket type)
IS  - 456  Code of practice for plain and reinforced concrete
IS  - 1343  Code of practice for prestressed concrete
IS  - 3370  Code of practice for concrete (Part I to IV structures for storage of liquids
IS  - 3935  Code of practice for composite construction
IS  - 3201  Criteria for design and construction of precast concrete trusses.
IS  - 2210  Criteria for the design of R.C. shell structures and folded plates.
IS  - 3558  Code of practice for use of immersion vibrators for consolidating concrete
IS  - 3414  Code of practice for design and installation of joints in buildings
IS  - 2571  Code of practice for laying in situ cement concrete flooring

In addition to the above mentioned codes the engineer-in-charge may specify any other standard for special materials and construction.

3.4. SUBMITTALS

3.4.1. MATERIALS REPORTS

Prior to the start of delivery of materials required for cement concrete the following shall be submitted by the Contractor to the Engineer for approval.

i) Recommended suppliers and/or sources of all ingredients for making concrete including cement, fine and coarse aggregates, water and additives including samples thereof.
ii) Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the Engineer on the quality of materials being supplied.

3.4.2. MIX DESIGN

i) The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements as specified.

ii) Well in advance to commencement of concreting work the contractor shall submit the proposal of mix design and test results from approved laboratory thereof as a report for the approval of the Engineer.

iii) However NKDA reserves the right to adopt a design mix as designed by and reputed educational institution like Jadavpur University, BESU etc. which the contractor needs to adhere to during the work.

3.4.3. PLANT AND EQUIPMENT

The contractor shall submit the proposed programmed, methods and details of plant and equipment to be used for batching, mixing of concrete and transportation of concrete to the Engineer, well in advance prior to start of work. The contractor will have to set up a batching plant within the site prior to start of the work.

3.4.4. CERTIFICATES

i) With each mix design, the Contractor shall submit laboratory test reports on concrete cubes and as well as on ingredients along with manufacturer's certificates attesting that ingredients have been taken from materials to be used at the actual construction work and conforms to specifications for approval of the Engineer.

ii) In case the source, brand or characteristic properties of the ingredients are required to be varied during the term of the contract, a revised laboratory mix design report shall be submitted to the Engineer.

3.4.5. REPORTS FOR INSPECTION AND TESTING

During concreting operations, the contractor shall conduct inspection and testing as described in relevant subsection hereinafter and all reports thereon shall be submitted in a summary form to the Engineer.

3.4.6. SCHEDULES

The Contractor shall prepare working schedules for dates and quantity, location of pouring of concrete for each item of work and submit same to the Engineer at least 48 hours before commencement of such work.

3.5. MATERIAL SPECIFICATIONS

Before bringing to the site, all materials for cement concrete shall be approved by the Engineer. All approved samples shall be retained in the office of the Engineer before placing orders for the materials with suppliers. The materials brought on to the works shall conform in every respect to their approved samples.

Fresh samples shall be delivered to the Engineer whenever type or source of any material changes. The contractor shall check each fresh consignment of materials as it is brought on to the works to ensure that they conform to the specifications and/or approved samples.

The Engineer shall have the option to have any of the materials tested to find whether they are in accordance with specifications. All bills, vouchers and test certificates which in the opinion of the Engineer are necessary shall be produced for his inspection when required.
Any materials which have not been found to conform to the specifications and not approved by the Engineer shall be removed from the site by the contractor within the time stipulated by the Engineer.

3.5.1. CEMENT

i) The cement used shall be Ordinary Portland Cement conforming to IS 8112: 1989 (43 grade).

ii) Whenever possible all cement of each type shall be obtained each from one constant source throughout the contract. Cement of different types shall not be mixed with one another. Different brands of cement, or the same brand of cement from different sources, shall not be used without prior notification and approval.

iii) The cement shall be supplied either packed in bags or in silos installed for the purpose of supply. Packed cement shall be delivered to the site in original sealed bags which shall be labeled with the weight, date of manufacture, name of manufacturer, brand and type. Cement received in torn bags shall not be used. Moreover bags of cement which vary in weight by more than 3% shall not be accepted.

iv) In fair faced elements, the cement used in the concrete for any complete element shall be from a single consignment. All cement for exposed concrete shall be from the same approved source and uniform in color.

v) With each and every delivery of cement the contractor shall provide the manufacturer's certificate that the cement conforms to the relevant Indian Standard.

The Contractor shall provide facilities for making 7 days tests from time to time in accordance with IS:3535: 1986, IS:4031 (Latest edition) and IS:4032 : 1985 and shall allow for carrying out such tests as may be required by the Engineer and for reporting the results.

3.5.2. AGGREGATES

i) Aggregates from natural sources shall be in accordance with IS – 383: 1970. The Contractor shall submit to the Engineer certificates of grading and compliance from the suppliers for all consignment of aggregate. In addition from time to time, the Contractor shall test that aggregate at site in accordance with IS – 2386: 1963 (Parts 1, 2 & 3). The contractor shall allow for and provide all necessary apparatus for carrying out such tests and for supplying test records to the Engineer. The aggregates shall be free from salts or other harmful chemical impurities.

ii) The contractor shall ensure that aggregates are free from iron pyrites and impurities which may cause discoloration.

iii) FINE AGGREGATE

a) The fine aggregate shall be pit sand or stone dust or other Badarpur sand as approved by the Engineer. It shall be free from clay, loam, earth or vegetable matter and from salt or other harmful chemical impurities. It shall be clean, sharp, strong, angular and composed of hard silicious material. Fine sand shall be within the limits of Grading Zone-IV given in Table I. When the grading falls outside the percentage limits given for sieve other than 600 micron, 300 micron and 150 micron (I.S.) sieve but not more than 5%, it shall be regarded as falling within this Zone. The 5 per cent shall be summation of excess on all other sieves.
**TABLE**

<table>
<thead>
<tr>
<th>I.S. Sieve Designation</th>
<th>Percentage Passing for Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone-I</td>
</tr>
<tr>
<td>10 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>60-95</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>30-70</td>
</tr>
<tr>
<td>600 micron</td>
<td>15-34</td>
</tr>
<tr>
<td>300 micron</td>
<td>5-20</td>
</tr>
<tr>
<td>150 micron</td>
<td>0-10</td>
</tr>
</tbody>
</table>

b) For coarse sand the grading of sand as determined by the method prescribed in IS – 2386 (Part-I): 1963 shall be within the limits of Grading Zone III given in Table I. When the grading falls outside the percentage limits given for sieves other than 600 micron, 300 micron and 150 micron (I.S.) sieves but not more than 5 percent, it shall be regarded as falling within this zone. The 5 percent can be excess summation on one or more sieves.

c) The maximum quantity of silt as determined by the method prescribed in I.S - 2386 (Part 2): 1963 shall not exceed 8 percent.

d) COARSE AGGREGATE

a) The coarse aggregate shall be crushed stone, approved river shingle or pit gravel having nominal maximum size of 20 mm and down as approved by Engineer.

b) Coarse aggregate obtained from crushed or broken stone shall be angular, hard, strong, dense, durable, clean and free from soft, friable, thin flat, elongated or flaky pieces.

c) River shingle or pit gravel shall be rounded, sound, hard, clean, nonporous, suitably graded in size with or without broken fragments and free from flat particles of shale, clay silt, loam and other impurities.

**3.5.3. WATER**

i) Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh and clean, free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

ii) Water shall be from the source approved by the Engineer-in-Charge and shall be in accordance with clause 5.4 of IS-456: 2000.

iii) Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory.

**3.5.4. ADMIXTURES AND ADDITIVES**

i) Chemical admixtures shall conform to IS-9103:1979 and are not to be used unless permitted by the E-I-C. In case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall be submitted to the Engineer for approval.
ii) The contractor shall further provide the following information concerning each admixture to the E-I-C-

a) Normal dosage and detrimental effects if any of under dosage and over dosage.
b) The chemical names of the main ingredients in the admixture.
c) The chloride ion content if any expressed as a percentage by weight of admixture.
d) Whether or not the admixture leads to entrapment of air when used in the manufacturer's recommended dosage.
e) Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility.

iii) In reinforced concrete, the chloride ion of any admixture used shall not exceed 2 percent by weight of the admixture as determined in accordance with IS-6925: 1973 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.83 percent by weight of cement.

iv) The admixtures when used shall conform to IS-9103:1979. The suitability of all admixtures shall be verified by trial mixes.

v) The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

vi) Retarding admixtures when used shall be based on lignosulphonates with due consideration to clause 5.2 and 5.3 of IS-7861 (Part 1): 1975.


3.6. PROPORTIONING, BATCHING & MIXING OF CONCRETE

3.6.1. PROPORTIONING

AGGREGATE

The proportions, which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batchers conforming to I.S. 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by engineer-in-charge to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiled well in advance of use.

CEMENT
The cement shall be considered by weight, for design mix.

WATER

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete as per specified water-cement ratio. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

DEFINITION OF WATER/CEMENT RATIO

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.
The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by the engineer-in-charge.

**PROPORTIONING BY WATER/CEMENT RATIO**

The W/C ratio specified for use by engineer-in-charge shall be maintained. Contractor shall determine the water content of the aggregates as frequently as desired by the engineer-in-charge as the work progresses and as specified in IS 2386 (Part III) and the amount of mixing water added at the mixer shall be adjusted as directed by the engineer-in-charge so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

### 3.6.2. BATCHING AND MIXING OF CONCRETE

3.6.2.1. The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the engineer-in-charge.

3.6.2.2. If approved by the engineer-in-charge concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in Para 9.2.2 or I.S. 456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with I.S. 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour for the minimum period of 2 minutes after all the materials and water is in the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the engineer-in-charge. The contractor should carry any rectifications immediately if found necessary.

3.6.2.3. Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up levelled on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately.

3.6.2.4. Each time the work stops, the mixer shall be cleaned out and before the next mix is commenced, the first batch shall have 10% additional cement.

### 3.6.3. BATCHING AGGREGATE BY VOLUME

3.6.3.1. Obtain approval before using this method.

3.6.3.2. Batch cement by weight and water by either weight or volume.

3.6.3.3. Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.

3.6.3.4. Concrete shall be mixed in concrete mixers until a uniform distribution of the material, and a uniform colour and consistency is obtained.
3.6.3.5. Concrete mixing shall in no case be less than two minutes.

3.6.3.6. Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.

3.6.3.7. The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.

3.6.3.8. Do not modify the mixed concrete either by addition of water or cement or other means.

3.7. CLEANLINESS

3.7.1. The mixer and handling plant should be washed with clean water at the end of the work and at intervals of 30 minutes during mixing.

3.7.2. If old concrete mix remains in the mixer drum, the drum should be rotated with clean aggregate and water before mixing the cement.

3.8. PLANNING OF CONCRETING OPERATION

3.8.1. Engineer-in-charge shall be informed 24 hrs in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and supporting props.

3.8.2. The spaces to receive concrete should be cleared free from debris and should be free from water. Following issues are to be noted while planning of concrete pours:

3.8.3. Slabs: to be cast in strips and not in alternate bays.

3.8.4. Walls: to be cast in successive pours working away in both directions from the center without shrinkage gaps except for final closure.

3.8.5. Starters: shall be the same as for the main member and shall be vibrated / rammed into place and prepared as for other joints. Starters to be cast for walls monolithically with foundation. In case of columns, they can be cast after concreting of foundation / slab.

3.9. ORDINARY CONCRETE (PLAIN CEMENT CONCRETE)

3.9.1. Ordinary cement concrete where specified shall be used

3.9.2. Proportions 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.

3.9.3. Cement shall be weighed based on 1 cum. of cement weighs 1440 kgs or 1 full bag of cement 50 kgs corresponding to 35 lts. by volume.

3.9.4. Correction factors to be applied for bulking of sand when the sand is either wet or moist.

3.9.5. Water cement ratio used shall be just sufficient for the workability of concrete.

3.9.6. Minimum strength of concrete shall be obtained as below:
<table>
<thead>
<tr>
<th>S No</th>
<th>Proportion of concrete</th>
<th>Preliminary tests</th>
<th>Work tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1:3:6</td>
<td>135 kg/sq.cm.</td>
<td>100 kg/sq.cm.</td>
</tr>
<tr>
<td>2.</td>
<td>1:2:4</td>
<td>200 kg/sq.cm.</td>
<td>150 kg/sq.cm.</td>
</tr>
<tr>
<td>3.</td>
<td>1:1½:3</td>
<td>265 kg/sq.cm.</td>
<td>200 kg/sq.cm.</td>
</tr>
</tbody>
</table>

Comprehensive strength of concrete shall be obtained by testing 15 cm. cubes at 28 days curing.

3.9.7. Testing: 6 cubes shall be taken from any mix, 3 of them to be tested at 7 days, 3 at 28 days.

3.9.8. Strength of concrete at 7 days shall be 2/3rds of the strength of concrete at 28 days.

3.9.9. Strength of concrete at 28 days shall be as mentioned in table above and the criteria for accepting concrete are only the strength of concrete at 28 days.

### 3.10. REINFORCED CEMENT CONCRETE

RCC comprises of formwork, reinforcement and concrete. Payment of Reinforced Cement Concrete shall be item wise as specified in the BOQ. Concrete shall be classified by its compressive strength at the 28th day. The concrete grade shall be as designated in Table 2 of IS: 456-2000.

Bill of Quantities shall specify various types of concrete aimed to be used in the Project. It shall be the Contractor’s responsibility to carry out Design mixes and approval of the same from the Developers Representative well in advance of the actual pouring of concrete at the Site in the permanent works.

The basic aim of Mix Design shall be to find the most economic proportion of cement, aggregate and water which will give the desired target mean strength of concrete, workability and durability for specified grade of concrete. Also it is important that the Mix should be easily workable with the help of equipment available at the Site. The operations involved are measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS Specifications and IS Codes of Practice, namely IS: 456-2000 and S P –23-1982.

In order to ensure that not more than the specified proportions of test results are likely to fall below the characteristic strength, the concrete mix has to be designed for higher average compressive strength for a specified grade of concrete and the same is defined a target mean strength.

### 3.10.1. DESIGN MIX AND TRIAL MIXES

Design Mix and weigh batching will be done as approved by the engineer-in-charge. The Contractor shall submit to the Engineer-in-charge/ Client the tentative Mix Design it proposes to use at the site.

On receipt of the above, the engineer-in-charge may immediately order to carry out work or site test before the final approval. This shall be done with the mixer, weigh batches, etc. and materials actually used in the Project.

This shall give the Contractor additional chance to check for itself actual workability and make sure that the mix proposed by it will be satisfactory with regards to slump, water-cement ratio and workability.

Test cubes shall be of size 150mm x 150mm x 150mm. These are to be legibly marked with location and date of concreting. Where concrete (in works) is to be vibrated or not vibrated, the cubes are to be cast as per IS Standards.

Where the concrete in the works is un-compacted, the concrete is to be poured into the mould in three layers and compact each layer is to be compacted with a 16mm dia tamping rod. Six (6) cubes shall be taken from each of the three batches to test the mix. Cube shall be cast, stored, cured, transported and tested as per IS:516-1959. The test may be carried out at the Site or at laboratory as approved by the engineer-in-charge.
TRIAL MIX

Within 7 days of signing the contract and before commencing work on site, the agency is to prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.

The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum requirement, make further trial mix is to be made, increasing the proportion of cement if necessary to obtain the required strength.

If any test results from any one-trail mix fails to exceed the minimum strength at 28 days:
Site materials from which the trial mix was prepared is to be removed.
New materials are to be provided and prepared and test further trial mixes are to be tested until specified requirements are achieved.
The Design Mix shall hold good so long as the materials continue to be of the same quality and from the same source. Minor adjustments are to be done daily based on the tests of materials used.

Compression strength on 150mm. Cubes

<table>
<thead>
<tr>
<th>Grade of concrete at 28 days</th>
<th>Preliminary test minimum kg/sq.cm</th>
<th>Work test minimum kg/sq.cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>M10</td>
<td>135</td>
<td>100</td>
</tr>
<tr>
<td>M15</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>M20</td>
<td>260</td>
<td>200</td>
</tr>
<tr>
<td>M25</td>
<td>320</td>
<td>250</td>
</tr>
<tr>
<td>M30</td>
<td>380</td>
<td>300</td>
</tr>
<tr>
<td>M35</td>
<td>440</td>
<td>350</td>
</tr>
<tr>
<td>M40</td>
<td>500</td>
<td>400</td>
</tr>
</tbody>
</table>

Control concrete shall be proportioned to obtain the required strength by conducting lab tests using the coarse aggregate, sand and cement based on the design mix.

Control concrete shall have suitable workability for proper consolidation.

At places having heavy reinforcement when compacting concrete is a problem, the control concrete shall be designed with special care to the required strength and workability at no extra cost.

Testing facilities to access the moisture content of aggregate at frequent intervals, testing of concrete cubes and testing of aggregate shall be done at the site by establishing testing laboratories. Concrete shall be weigh batched. The dials of weigh-batching units shall be checked with standard weights periodically.

Under special circumstances the conversion of weights to volumes may be allowed by the Engineer-in-charge.
The minimum cement content to be used for the job is as follows:

<table>
<thead>
<tr>
<th>43 GRADE</th>
<th>53 GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 15</td>
<td>280 Kg/cum</td>
</tr>
<tr>
<td>M 20</td>
<td>318 Kg/cum</td>
</tr>
<tr>
<td>M 25</td>
<td>350 Kg/cum</td>
</tr>
</tbody>
</table>
Note: These are minimum quantity of cement to be used irrespective of the design mix.

Further the Contractor has to provide and maintain all the equipment and stock at the Site throughout to carry out the following tests in a small Site laboratory or get these tests done from approved laboratories without extra cost to the Contract.

i) Grading of aggregate
ii) Silt content of sand
iii) Moisture content of aggregate
iv) Slump test of concrete mix
v) Concrete cube test

The Contractor shall maintain full records for all above tests in a register. The format of the records shall be prepared in consultation with the Engineer-in-charge/Client. It shall have full access to the Contractor’s site laboratory. The Contractor shall include charges for these in its rates and no extra whatsoever shall be payable on this account of designing, testing, maintaining laboratory, etc.

3.10.2. ASSUMED STANDARD DEVIATION

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table below may be assumed.

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>Assumed Standard Deviation N/Sq.mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 10</td>
<td>2.3</td>
</tr>
<tr>
<td>M 15</td>
<td>3.5</td>
</tr>
<tr>
<td>M 20</td>
<td>4.6</td>
</tr>
<tr>
<td>M 25</td>
<td>5.3</td>
</tr>
<tr>
<td>M 30</td>
<td>6.0</td>
</tr>
<tr>
<td>M 35</td>
<td>6.3</td>
</tr>
<tr>
<td>M 40</td>
<td>6.6</td>
</tr>
</tbody>
</table>

3.10.3. STANDARD DEVIATION BASED ON TEST RESULTS

3.10.3.1. Number of test results - Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.

3.10.3.2. Standard deviation to be brought up to date - the calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

3.10.4. DETERMINATION OF STANDARD DEVIATION

3.10.4.1. Concrete of each grade shall be analyzed separately to determine its standard deviation.

3.10.4.2. The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.

3.10.4.3. Estimated standard deviation $S=\sqrt{\frac{\sum (x-\mu)^2}{n-1}}$ where $n$ = number of sample test results.
3.10.4.4. When significant changes are made in the production of concrete batches (for example changes in the materials used, mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

3.10.5. MIXING OF CONCRETE

Weigh Batching shall be followed if mixed at the site for all structural concrete works. The Contractor shall provide Concrete Batch Mixers, Vibrators, Weigh Batchers conforming to relevant IS Specifications and from approved and recognized manufacturers. The capacity and number of mixers and vibrators required at the Site from time to time shall be to the approval of engineer-in-charge. No equipment from the site shall be removed without the prior written approval of the engineer-in-charge. The Contractor shall maintain a platform weighing scale of capacity 300 kg with fraction of 100 gm at the site.

The machine will have to be got calibrated by the Contractor once in every two weeks or after 200 cum of concrete whichever is earlier, and records of these calibrations shall be maintained. The dials of the weigh batchers shall be checked with standard weights periodically.

3.10.6. CONSISTENCY

The concrete which will flow freely into the forms and around the reinforcement without any segregation of coarse aggregates shall be used. The consistency shall depend upon the type of vibrator etc. to be used. The controlling factor for the same is the Slump Test.

When considered necessary by the engineer-in-charge, the workability of the concrete shall be ascertained by compacting factor test and VEE BEE consist meter method as per IS:1199-1959.

3.10.7. TEMPERATURE OF CONCRETE

The placing temperature of concrete shall not be more than 38 degrees Celsius. If it is more, the engineer-in-charge may order addition of ice or chilled water to the concrete. Also the Contractor shall take following precautions:

1. Mixer and Weigh Batcher shall be painted white color.
2. Aggregate storing bin shall not be exposed to the sun.
3. Water shall be sprinkled on aggregate well before concreting to keep the temperature low.

Similarly, during the cold weather, concreting shall not be done when the temperature falls below 4.5 Degrees Celsius. The concrete placed shall be protected against by suitable covering. The concrete damaged by frost shall be removed and work redone with no extra cost.

3.10.8. SHRINKAGE CRACKS

Concreting shall be avoided in very warm weather. Under such circumstances, the placed concrete shall be covered with damp Hessian cloth within two hours of placing of concrete.

To achieve good result the concrete shall be immediately covered with a plastic sheet and not allowed to any direct wind contact to eliminate shrinkage cracks.

3.10.9. WORKMANSHIP

All works shall be true to level, plumb and square and all corners and edges in all cases shall be unbroken and neat.

Any work not to the satisfaction of the Engineer-in-charge will be rejected and the same should be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.
3.10.10. TRANSPORTATION

Concrete shall be transported with the help of pumps of sufficient capacity to achieve necessary heights wherever required from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability. The pumps can be either compressor type or boom type. All the pumping equipments have to be maintained and kept operational by the contractor.

3.10.11. PLACING OF CONCRETE

Placing of concrete shall be done using pumps only at all levels. The pumps shall be of sufficient capacity to achieve necessary heights wherever required.

The slump of concrete placed with the help of pumps shall not be more than 100mm unless otherwise instructed by the Engineer-in-charge/Client. Concreting shall commence only after formwork is approved and reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Engineer-in-charge/Client.

Formwork should be clean, free from dust, pieces of wood or any other foreign material. It should be treated by form releasing agent prior to the laying of reinforcement and concrete, based on sample approved by the Engineer-in-charge/Client prior to start of construction at Site. Concrete shall be as gently deposited as is practically possible, in its final position to avoid remanding and shall be so deposited that segregation of aggregates do not occur. In case of deep trenches and footings, it may be done with the help of chutes. Concrete from wheelbarrows shall not be dumped away from the face of concrete already been placed. It shall be dumped into the face of concrete already in place. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Engineer-in-charge/Client. No concreting shall be done within half an hour of the closing time of the day, unless permitted by the Engineer-in-charge/Client.

Concrete shall not be dropped into position from a height greater than 1.0 meter unless otherwise directed by the Owner/Employer/Consulting Engineers/Consultant. Concrete shall be placed into the forms in layers not exceeding 300 mm (approx.) in thickness. Concrete after placing shall be protected by use of covering as approval by the Owner/Employer/Consulting Engineers/Consultant during first stage of hardening against high winds, hot and/or rain or surface water. No shock or vibration shall be allowed to be imparted to forms supporting fresh concrete.

For concreting of slabs and beams wooden plank or catwalks of chequered MS plates or bamboo mats or any other suitable materials supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of final deposition without disturbing the reinforcement in anyway. In no case labour or any other persons are allowed to walk over the reinforcement.

Concrete shall be thoroughly compacted into a dense mass as depositing shall proceed by means of suitable vibrators. The vibrator shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during whole period occupied by placing of concrete. Care should be taken not to over-vibrate the concrete. While vibrating no holes should be visible in concreting. Compaction should be completed before the initial setting time. Compaction shall be done till air bubbles cease to appear. Concrete already set shall not be disturbed by successive vibration.

Hand tamping shall not be permitted. But only in exceptional cases, depending on the thickness of the members and feasibility of vibrating the same, the Engineer-in-charge/Client may permit hand tamping.
Hand tamping or compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement embedded fixtures, and into the corners of the form work.

The layers of concrete shall be so placed that the bottom layer does not finally set before the top layers are placed. The vibrators are so applied so that the centre of mass is being compacted at the time of placing of concrete.

3.10.12.1 VIBRATION OF CONCRETE:

a) Water Cement Ratio: The water cement ratio (by weight) for all vibrated concrete (except controlled concrete) shall generally be 0.45 and it shall be not varied unless otherwise directed. In respect of “CONTROLLED CONCRETE”, the water cement ratio shall be as determined in laboratory mix design suitable for vibrated concrete.

b) Placing: Concrete shall be placed in layers not over 45 to 60 cm (18 to 24 inches) deep and each layer shall be vibrated into places by methods which will not permit the ingredients to separate. Surfaces shall be smooth and free from voids caused by stone pockets, where necessary vibration shall be supplemented by hard packing to secure these results.

c) Number & Size of Vibrators: (Either Needle or Surface Vibrator) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3000 impulses per minutes when operating under load. The vibration shall be sufficiently tense to cause the concrete to flow or settle rapidly in the space and visibility affect the concrete over a radius of at least 450 mm (18") when used in concrete having slump of 25 mm. A sufficient number of vibrators (at least one vibrator for a rate of concreting of 1.5 cm (50 cft) per hour shall be employed so that at the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured without segregation.

d) Manipulation of vibration: Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly placed not further apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from surrounding concrete. The vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 200 seconds of vibrations per sq.ft of surface of each layers of concrete, computed on the basis of visibly affected radius and taking overlap into consideration.

Care shall be taken to ensure that at no time the vibrators and /or vibration action is used to push the concrete ahead. Vibrators shall be applied systematically to overlap zones of influence.

It shall be ensured that the needle vibrators are not applied directly on the reinforcement on the formwork which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use the standby petrol, diesel or kerosene vibrator should always be available at the concreting point.

3.10.13. CONSTRUCTION JOINTS

Construction joint shall be avoided as far as possible. If provided, concreting shall be carried out continuously up to the construction joints as directed by the Engineer-in-charge/ Client and/or at the
location and arrangement shown in the structural drawings. However, the number of such joints shall be kept to a minimum and they shall be as straight as possible.

a) **COLUMNS**:
Joints shall be framed horizontally at the top of foundation and (75 mm) below the lowest soffit of the beams meeting at the head of the column. Concrete in the head of a column where one more beams meet shall be placed without a joint.

b) **BEAMS**:
Concrete in the beams shall be placed without a joint but if the provision of joint is unavoidable the joint shall be vertical and at one third of the span or at position approved by the Owner/ Employer/ Consulting Engineers/ Consultant.

c) **SLAB**:
A joint in the slab shall be vertical and parallel to the principal reinforcement, where it is unavoidable and at right angles to the principal reinforcement the joint shall be vertical and at one third of the span.

d) **TREATMENT OF CONSTRUCTION JOINTS**

i) When work is resumed on the surface which has hardened, the surface shall be roughened. It shall be thoroughly cleaned wetted and covered with a 4 mm layer of cement-sand paste in the ratio of 1:1 added with anti-shrinkage compound like “Convex-100” or similar produce as per manufacturer’s specification. This 4 mm layer of paste shall be freshly mixed and placed immediately before the placing of the concrete.

ii) Where the surface has not fully hardened the laitance shall be removed by scrubbing the wet surface with wire bristle but care being taken to avoid dislodgement of aggregates. The surface shall be thoroughly wetted and all free water removed. Surface shall then be coated with neat cement sand paste as specified above.

iii) Care shall be taken to obtain good bond between the hardened freshly placed concrete. Ramming and moulding of concrete around water bars shall be carefully carried out. Labour and materials for treatment of concrete joints fare to be included in the of respective items.

Before commencement of concreting after a break, adjacent concrete stopper and surfaces shall be cleaned, chipped free of any loose mortar and roughened to expose the aggregate and than brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

3.10.14. **EXPANSION JOINT**
As indicated in drawing or as directed by the engineer-in-charge.

3.10.15. **CURING**
Curing of concrete is most important. There shall be no compromise on this activity as it is for the Contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Engineer-in-charge/ Client. As said above after concrete has begun to harden, i.e. about 1 to 2 hours after laying , it shall be protected from quick drying with moist or damp hessian cloth or any other material approved by the Engineer-in-charge/ Client. After 24 hours of laying of concrete, the surface shall be cured by flooding with water or covering with moist hessian cloth for period of 7 days to keep it moist. For the next seven days surface shall be kept wet all the time by sprinkling water continuously.
In order to properly monitor the curing activity, the Contractor shall write legibly with paint, the date of casting the concrete of each member of the structure which shall remain clearly visible at least till the completion of curing at least.

3.10.16. FINISHING

Concrete surface shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted:

Roof shall be troweled even and smooth with a wooden float, before the concrete begins to set.
Surface that will receive plaster shall be roughened immediately.
Surfaces that will be in contact with masonry shall be roughened immediately.
Surfaces that will receive floor finishes, tiling, etc. shall be roughened while it is still green.
Every care shall be taken not to disturb the freshly laid concrete.
For Ramps and Basements concrete shall be broom-finished.

On finishing standards and quality/workmanship, the decision of the Engineer-in-charge/Client shall be final and binding on all parties.

3.10.17. INSPECTION AND CORRECTIVE MEASURES

Immediately on removal of formwork, the RCC surface shall be examined by the Engineer-in-charge/Client. Till such time, no remedial measures shall be carried out by the Contractor. All remedial actions including breaking, if any, shall be on the instructions of the Engineer-in-charge/Client. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Engineer-in-charge/Client in this regard shall be final and binding to all parties.

Sagged, bulged, patched, honeycombed work to an extent detrimental to structural safety or aesthetics according to the engineer-in-charge shall stand to be rejected and the Contractor shall rectify by breaking or redoing, if required, as directed by the Engineer-in-charge/Client and all expenses incurred due to this shall be to the Contractor’s account.

Surface defects minor in nature may be accepted as a special case by the Engineer-in-charge (but can't be considered as a precedence) whose decision in this matter is final and binding on the Contractor. Once accepted, the defects shall be rectified as follows and all expenses incurred due to the rectification process, shall be to the Contractor’s account.

3.10.17.1. Surface defects which require repair when forms are removed, usually consist of bulges due to the movement of forms, ridges at form joint, honey combed areas, damage, resulting from the stripping of forms and bolt holes. Bulges and ridges are required to be removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey combed and other defective areas must be clipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly undercut to provide a key at the edge of the patch.

3.10.17.2. If permitted in writing by the E-I-C’s Representative, shallow patches are first to be treated with a coat of thin grout composed of one part of cement and one part of fine sand added with polymer modified cementations material as per manufacturer’s specification, and then filled with mortar (mixed with non-shrink additives) similar to that used in concrete. The mortar should be placed in layers not more than 10 mm thick and each layer is to be given a scratch finish to secure a bond with the succeeding layer. The laid layer is finished to match with the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

3.10.17.3. Or as an alternative to the above, as directed by the Engineer-in-charge/Client, the patch-work shall be treated with epoxy based proprietary items like non-shrinking grouts etc. available in the
market. In such cases, the methodology as indicated by the manufacturer of the item shall be followed if permitted in writing by the Engineer-in-charge.

3.10.17.4. Large and deep patches require filling up with concrete held in place with forms. Such patches should be reinforced and carefully drawled to the hardened concrete.

3.10.17.5. Or as an alternative to the above, epoxy based proprietary items like grouts as directed by the Engineer-in-charge/ Client, shall be used. The methodology as specified by the manufacturers shall be strictly adhered to.

3.10.17.6. Holes left by bolts are to be filled with non-shrink grouts, as specified and directed by the Engineer-in-charge/ Client. carefully packed in to places in small amounts. The mortar is mixed as dry as possible to allow enough water to go into it, so that it will be tightly compacted when forced into the place.

3.10.17.7. Tiered holes extending right through the concrete may be filled with mortar or non-shrink grout, as the case may be, with pressure gun.

3.10.17.8. Normally, patches appear darker than the surrounding concrete when uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of while Portland cement to the patching mortar, the actual quantity being determined by trial.

3.10.17.9. The same amount of care shall be taken to avoid the material in the patches as with the whole structure. Curing shall be started immediately after packing is done to prevent early drying. A membrane curing compound is these cases will be most convenient.

3.10.18. CRACKS

Cracks observed shall be examined. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Engineer-in-charge and the following procedure shall be followed:

3.10.18.1. Cracks not propagating/developing further and according to the engineer-in-charge not detrimental to the strength of the construction shall be grouted with non-shrinking epoxy based cement slurry or as directed by the Engineer-in-charge/ Client.

3.10.18.2. Cracks developing further and felt detrimental to the strength of construction shall be tested as per the relevant Indian Standards.

3.10.18.3. Based on results, the engineer-in-charge shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequent works thereto as directed/ specified.

3.10.18.4. Cost of above shall be borne by the contractor if the failure is on its part unless it is due to a design fault, decided at the discretion of the Engineer-in-charge/ Client.

Decision of the Engineer-in-charge/ Client in the matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.10.19. QUANTUM OF CUBE TESTING

The minimum frequency of cube testing shall be as follows. Each set of sample shall consist of 6 cubes.

<table>
<thead>
<tr>
<th>Concrete Quantity</th>
<th>Number of Sample sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 cum a day</td>
<td>1</td>
</tr>
</tbody>
</table>

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### 3.10.20. ACCEPTANCE OF WORK

It shall be in accordance with in IS: 456-2000, SP-23 and SP-24. The guidance brief is elaborated below. Part or element of work shall be deemed to be accepted, provided the results of the 28th day cube testing confirm to the criteria stated as under:

3.10.20.1. The average of the three consecutive cubes strength shall not be less than specified strength.

3.10.20.2. No individual cube strength shall be less than 90% of the specified strength.

3.10.20.3. If the individual cube strength exhibit more than 133% of the specified strength such a cube shall be specified as freak and the criteria in above two points shall be applied to remaining two cubes and their acceptability determined.

3.10.20.4. If cubes fail at 7 days, defective concrete can be dismantled, removed and replaced without awaiting 28 day test results.

3.10.20.5. If the concrete tests fail to meet the acceptance strength required for respective grades of concrete, the Engineer-in-charge/Client may take one of the following actions:

3.10.20.6. Instruct Contractor to carry out such additional tests (e.g. Core tests, load tests, ultrasound, etc.) and/or remedial measures to ensure the soundness of the structure at the Contractor’s expense.

3.10.20.7. The work will be rejected and any consequential action as needed shall be taken at the Contractor’s expense, including cutting out and replacing a part or whole of work.

### 3.11. READY MIX CONCRETE

#### 3.11.1. GRADES AND STRENGTH REQUIREMENTS OF CONCRETE

**GENERAL**

Ready mix Concrete shall consist of the material described under site batched concrete sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the of mix design already adopted. The overall grading shall be such as to produce concrete of the specified quality which will work readily into position without segregation. The ready mix concrete shall conform to IS:4926 and shall be delivered in agitating trucks. The RMC may contain flyash as per the acceptable norms. (Maximum 20% of cement content)

**SLUMP**

The water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked into the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS. 456-2000 and when a suitable amount of water has been determined, the resulting consistency shall be maintained through out the corresponding parts of
the work and tests shall be conducted to ensure the maintenance of this consistency. The max slump at the point of the discharge should not exceed 110mm max.

CONCRETE GRADES

Grade of concrete used in the works shall be shown on the drawings or as directed by the Engineer-in-charge. The minimum cement used for M-20 shall be 300 Kg. Per Cum, 350 Kgs for M-25 and 400 Kgs for M-30. The mentioned quantity of cement indicates cementious material i.e., cement including fly ash.

3.11.2. TRANSPORTING CONCRETE

Concrete shall be transported in agitating trucks without contamination, loss of ingredients or segregation. Not more than 4 hours are allowed between the wetting of mix and discharge of the concrete at site. The RMC vehicle should carry a computer-generated slip/challan showing weight of all the ingredients including cement used, date and time of mixing and quantum of concrete carried.

3.11.3. CONCRETE PLACEMENT

GENERAL

Concrete, when deposited, shall have a temperature of not less than 5°C (41°F) and not more than 32°C (90°F).

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the Engineer-in-charge.

Contractor shall give adequate notice to the Engineer-in-charge of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the Engineer-in-charge is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorized or directed by Engineer-in-charge or his representative. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of the concrete and the removal of concrete in the case of segregation's.

PLACING CONCRETE IN COLD WEATHER

No concrete shall be mixed or placed while the ambient temperature is above 40°C on a rising thermometer or below 4°C on a falling thermometer. The contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position on the works. Aggregates that have been exposed to frost shall not be used until completely thawed. Concrete shall be maintained by approved means at a temperature of not less than 4°C during placing, and for a period of three days
thereafter. All concrete placed during cold weather or when a frost is predicted or is likely to occur or occurs contrary to expectation, shall be protected from freezing by approved means.

### PLACING OF CONCRETE IN WET WEATHER

Concrete shall not be mixed and or placed in rainy weather or when there is likelihood of impending heavy showers. If it becomes necessary to place concrete during rainy weather, the contractor shall provide adequate protection by means of tarpaulin or similar other waterproof material to immediately cover fresh concrete to prevent rain falling over it. This protection shall be left on the concrete for a period of 24 hours after placing of concrete.

### 3.11.4. QUALITY CONTROL

3.11.4.1. In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course or the works.

3.11.4.2. Workability testing shall be carried out in accordance with IS:456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the required workability is consistently achieved.

3.11.4.3. Not withstanding the foregoing, additional samples shall be taken by the contractor when directed by the Engineer-in-charge/ engineer-in-charge. The test cube procedure shall be in accordance with IS: 516 throughout.

### 3.11.5. SEVEN-DAY CUBE TESTS

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relation ship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. This relation ship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube strengths. The contractor shall without delay advise the Engineer-in-charge of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

### 3.11.6. ACCEPTANCE CRITERIA

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of IS. 456.

If any of the works tests are not up to the standard, the Engineer-in-charge/ engineer-in-charge shall have the power to stop the work until the reason is investigated and steps taken to prevent further low results. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the Engineer-in-charge. At the discretion of the Engineer-in-charge, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

### 3.12. PILING WORKS

#### 3.12.1. PARTICULAR SPECIFICATION FOR BORED CAST-IN-SITU PILES
Unless otherwise mentioned in the following paragraphs, stipulations of relevant section of I.S. 2911 shall be followed

3.12.2. The layout and number of piles shown in the Tender Drawing are based on allowable carrying capacity on the pile section as given in the drawing.

3.12.3. Boring equipment and accessories shall generally conform to I.S. 2911. Boring may be done by auger method for 20m. In case of unstable soils the boring tools used should be such that suction effects are minimized. Stabilization of the sides of the bore hole, shall be done by the use of bentonite slurry and casing if necessary. The size of cutting tool shall not be less than diameter of the pile by more than 75 mm.

3.12.4. The drilling mud shall be used at least from the level of sub soil water or from the level of bottom of M.S. liner depending upon site conditions and the hole shall than be always kept full with the fluid which should preferably be kept in motion. The density and composition of the fluid shall be such as to suit the requirements of the ground conditions and to maintain the fine materials from the borings in suspension. A 5 percent bentonite suspension would be generally suitable and its quality shall conform to specification given in Appendix `A' of I.S. 2911 (Part I/Sec-2).

3.12.5. The bottom of the hole shall be cleaned very carefully before concreting work is taken up. The cleaning of the hole shall be ensured by careful operation by air lifting process, unless otherwise allowed by the Engineer. To lift the mud at founding level before concreting, bore hole shall be agitated by jetting with relatively higher pressure than that used during boring through tremie pipe. While boring by use of drilling mud, the specific gravity of the mud suspension in the vicinity of the bottom of bore hole shall be determined by suitable slurry sampler in the first few piles and at suitable interval of piles and recorded. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting operation in order to keep the hole stabilized as well as to avoid concrete mixed up with thicker suspension of the mud.

3.12.6. In case of boring with casing, the casing should be used from the Ground level. The casing shall be kept ahead of boring in cases where there is danger of caving-in due to subsoil water entering into the bore hole or where the soil is loose.

While boring below sub soil water level, precaution shall be taken so that no boiling of the bottom of the hole occurs due to difference in hydrostatic head. Concreting of Bore holes shall start as soon as possible after its completion. Should a bore hole be left un-concreted for more than two hours it shall be cleaned thoroughly as directed by E-I-C before placing concrete.

3.12.7. Concreting shall be done in one operation. Concrete shall be placed by means of a tremie pipe the diameter of which shall be at least 8 times the size of the largest aggregate used in the concrete mix. The construction of and the method of handling the tremmie pipes shall be approved by the Engineer-in-charge. The pipes shall be waterproof and sufficiently strong to withstand severe handling conditions and any joints must be sealed with adequate gaskets. It shall, however be ensured that concrete entering the tremie pipe does not get mixed in with the slurry and 1/4 kg of granulated vermiculite shall be poured in the tremie pipe before pouring concrete as directed by the Engineer. At the commencement of tremmie work the bottom of the pipe shall be sealed before being lowered in to position. The seal shall only be broken by the concrete being placed. The concrete placed in contact with a horizontal construction joint shall have a lower proportion of coarse aggregate and a higher proportion of cement than the remainder of the concrete. The proportions of the mixes shall be agreed in accordance with the strength and workability required by the specification. To allow for losses an addition of 10% of cement shall be added to mixes of concrete scheduled to be placed under water.

3.12.8. The tremie pipes and funnel shall be filled and lifted just 15 cm above bottom before releasing the concrete column to facilitate flushing out the bottom. The concrete levels in the tremie shall be checked
every few feet in order to note the difference, if any, between the theoretical quantity that should have been placed and actual quantity that has gone in. This is to locate the position of over cut during boring.

3.12.9. In addition to the normal precautions to be taken in tremie concreting as per relevant section of IS: 2911 the following specifications shall be particularly applicable for the use of tremie concrete pipes:

1. The concrete shall be coherent, rich in cement (not less than 400 kg/cum) and of slump not less than 160 mm.
2. The hopper and tremie shall be a closed system embedded in the placed concrete, through which water can not pass.
3. The tremie shall be large enough with due regard to the size of the aggregate. For 20 mm aggregate the tremie pipe shall be of diameter not less than 200 mm, aggregates more than 20 mm shall not be used.
4. The first charges of concrete shall be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate size to prevent mixing of concrete and water. However, the plug shall not be left in the concrete as a lump.
5. The tremie pipe shall always penetrate well into the concrete with an adequate margin of safety against withdrawal of the pipe is surged to discharge the concrete.
6. The pile shall be concreted wholly by tremie and the method of deposition shall not be changed part way up the pile, to prevent the laittance from being entrapped within the pile.
7. All tremie tubes shall be scrupulously cleaned after use.

3.12.10. Normally concreting of the piles shall be uninterrupted. In the exceptional case of interruption of concreting but which can be resumed within 1 to 2 hours, the tremie shall not be taken out of the concrete. Instead it shall be raised and lowered slowly from time to time to prevent the concrete around the tremie from setting. Concreting should be resumed by introducing a little richer concrete with a higher slump for easy displacement of the partly set concrete.

3.12.11. If the concreting cannot be resumed before final set of concrete already placed, the pile so cast may be rejected or accepted with modifications at the sole discretion of the Engineer.

3.12.12. In case of withdrawal of tremie out of the concrete, either accidentally or to remove a choke in the tremie, the tremie may be reintroduced in the following manner to prevent impregnation of laittance of scum lying on the top of the concrete already deposited in the bore.

3.12.13. The tremie shall be gently lowered on to the old concrete with very little penetration initially. A vermiculite plug shall be introduced in the tremie. Fresh concrete of slump between 150 mm and 175 mm shall be filled in the tremie which will push forward and will emerge cut of the tremie displacing laittance/scum. The tremie will be pushed further in steps making fresh concrete sweep away laittance/scum in its way. When tremie is buried by about 60 to 100 cm concreting may be resumed.

3.12.14. The top of concrete in a pile shall be brought 1 metre above the cut off level to permit removal of all laittance and weak concrete before capping and to ensure good concrete at the cut off level for proper embodiment into the pile cap. Remaining length of bore is to be filled by silver sand.

3.12.15. When concrete is placed by tremie method, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection or to a minimum of one meter above cut-off level. In the circumstances, where cut-off level is below ground level the need to maintain a pressure on the onset concrete equal to or greater than water pressure shall be observed and accordingly length of extra concrete above cut-off level shall be determined and allowed in works.

3.12.16. In case, defective piles are formed, they shall be removed or left in place whichever is convenient without affecting performance of the adjacent piles or the cap as a whole. Additional piles shall be provided at contractor's cost to replace them as directed by the Engineer and in this regard Engineer’s decision shall be binding on the contractor.
3.12.17. Any deviation from the designed location alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting of the pile cap and plinth beam if the deviations are beyond the permissible limit. All such alterations shall be done at contractor’s cost.

3.12.18. Pile shall be installed accurately as possible as per the designs and drawings. Pile shall not deviate more than 75 mm or one-tenth of diameter whichever is more. In case of piles having diameter more than 600 mm it will not deviate more than 100 mm from their designed position. In case of single pile in a column, positional tolerance shall not be more than 50 mm.

3.12.19. In case of piles deviating beyond these limits and to such an extent that the resulting eccentricity can not be taken care of by a redesign of the pile cap or pile ties, the piles shall be replaced or supplemented by one more additional piles by the contractor at his own cost along with any additional cost for pile cap being over size. The decision taken in this regard by the Engineer shall be final and binding on the contractor.

3.12.20. Manual chipping shall be permitted after three days of pile casting. Pneumatic chipping if permitted by the Engineer shall not be start before 7 days. In case, Portland Pozzalana Cement is used, chipping shall only be started as directed by the Engineer.

3.12.21. When working near existing structures care shall be taken to avoid any damage to such structures. In case of cased bored pile, care shall be taken to avoid effect due to loss of ground.

3.12.22. In case of deep excavations adjacent to piles, proper shoring or other suitable arrangement shall be done to guard against the lateral movement of soil stratum or releasing the confining soil stress.

3.12.23. Main longitudinal reinforcement in the length of the piles as well as links or spirals shall be provided as shown in the drawing. Longitudinal bars shall preferably be in one length. Reinforcing cage shall be handled and installed carefully without damaging its shape.

3.12.24. All other requirements or reinforcement bars i.e. quality, workmanship etc. shall be specified for reinforced concrete work in the relevant I.S. Codes.

3.12.25. During installation of pile the following data shall be recorded along with any other date as directed by the Engineer. These data shall be submitted to the Engineer in triplicate on completion of installation of each pile.

a) Sequence of installation of piles in a group.

b) Dimensions of the pile, including reinforcement details and mark of pile.

c) Details of mild steel lines where provided along with stiffener.

d) Depth bored and founding level along with a bore level indicating nature of stratum.

e) Time taken for penetration of every 15 cm during last 2 m depth before founding level.

f) Method of cleaning bottom of hole at founding level before concreting.

g) Time taken for concreting.
h) Cut-off level/working level/RL of top of concrete.

i) Cement bag consumption, slump of concrete.

j) Any other relevant important observation

3.12.26. PILE TEST

The contractor shall quote separately for carrying out pile test for bored piles.

The test shall commence as per provision laid down in I.S. 2911 Part-IV 1979, latest revision.

Before any load test being performed, the proposed set-up and the kentledge (load frame) shall have to be approved by the Engineer-in-Charge.

The Engineer-in-Charge shall have the right to get test certificate regarding calibration of pressure gauge from the Govt. Laboratory, at the cost of contractor.

For each pile failing to conform to the specified requirements, the contractor shall at his expense, test further pile or piles as directed by the Engineer-in-Charge. The cost of all additional piles, and all other works necessitated due to failure of inadequacy of any test of pile to meet specified requirements shall be born by the contractor.

The results of pile test shall be graphically represented to show the following relations:

   i) Load vs. time

   ii) Total settlement vs. time

   iii) Load vs. total settlement (for loading and unloading).

   iv) Load vs. net settlement.

3.12.27. PROCEDURE FOR ROUTINE LOAD TEST ON WORKING PILE

i) Load to be applied by means of hydraulic jack with a pressure gauge with a remote control pump, reacting against suitable load frame;

ii) The reaction to be made available for the test should be 25% more than final test load proposed to be applied;

iii) The test load shall be applied in increment of about 20% of assumed safe load carrying capacity.

iv) Settlement should be recorded with minimum three dial gauges of 0.02 mm sensitive for single pile and 4 gauges for pile groups. Each positioned at equal distance around the piles, and normally held by datum bars resting on immovable supports at least 5D away from the periphery of test pile where ‘D’ is the diameter of pile;

v) Each stage of loading shall be maintained till the rate of movement of pile top is not more than 0.10 mm per hour in case of clayey soil or a maximum period of 2 hours whichever is greater. For this purpose, the type of soil met at the pile top shall be considered. The estimated safe load carrying capacity may be maintained for 24 hours and settlement should be observed every hour during this period;
vi) For each increment, application of load shall be as smooth as possible. Settlement observation shall 
be made at about 15 minutes interval;

vii) The loading shall be continued up to twice the safe load carrying capacity or the load at which total 
displacement of pile top/cap equals the appropriate value specified below, whichever is earlier;

a) Safe load carrying capacity on single pile 2/3rd of the final load at which gross 
settlement is 12 mm.

b) 50% of the final load at which gross settlement comes to 10% of diameter of 
pile.

Safe load carrying capacity on group of piles

a) 2/3rd of the final load at which gross settlement come to 40 mm.

b) Final load at which gross settlement comes 25 mm.

viii) The load on the pile may be removed in one stage by releasing jack steadily after completion of 
the test and rebound observations should be made for at least 2 hours.

3.12.28. RECORDS

The contractor shall prepare in triplicate, a comprehensive record during the driving of piles, giving the 
following and other necessary data in a tabular form:

i) Serial No. of Pile Driven.

ii) Date and time at which pile is driven.

iii) Total depth of pile.

iv) Strata chart in case of bored piles only.

v) Any other data ordered by the Engineer-in-Charge.

vi) For cyclic test, loading record should be as per I.S. Code 2911 (Part IV), 1979 
(latest revision).

Each of the three copies of such data prepared daily shall be signed by the contractor or his authorized 
representative as well as the Engineer-in-Charge. One copy shall be retained by the contractor and the 
other submitted to the Engineer-in-Charge for final record.

3.12.29. STANDARD OF ACCEPTANCE

The piles shall be accepted satisfactory only when the work has been executed in accordance with this 
specification and the standards stated hereinafter to the satisfaction of the Engineer-in-charge/Employer.

a) The pile shall not be out of plumb by more than 1.5%.

b) The toe of pile shall be at the approved bearing level in each case.

c) The total volume of concrete consumed for pile shall not be less than 10% and not more than 40% 
greater than the calculated volume. The calculated volume for this purpose shall be cross sectional 
area inside the casing multiplied by the length of pile.
The concrete shall show the specified strength as indicated by the cube test results.

d) The results of the load test carried out in accordance with the contract and with the specification for load testing shall be satisfactory.

3.12.30. BASIS OF MEASUREMENT OF PILES

The top eighty millimetres of each pile shall penetrate into the pile cap - the top of which shall be regarded as cut off level and reinforcement shall further project into the pile cap as specified.

The piles shall be measured in linear meter from the cut-off level to the bottom most point of the pile. The rate shall include the cost of driving the casing tube (if any), boring and placing in situ concrete including that in the portion inside pile cap. The rate shall also include for all labour and materials, if required, bailing out water from underground surface, withdrawing of the tube, breaking of boulders, old foundation etc met with before reaching the desired stratum, and everything necessary to have the pile in plumb and secure in position.

No payment will be made for piles driven out of plumb beyond the specific tolerance limits, or for imperfect or defective piles regarding which the judgment of the Engineer-in-Charge shall be final and binding on the contractor.

3.12.31. DEFECTIVE PILES

Any pile which is shown to be defective under load test shall not be accepted and the Engineer-in-Charge/Employer will relate such failure to the acceptance of other piles in the area.

If an individual pile should fail to meet the requirements specified in Clause G as stated above, such pile shall be deemed to be defective and the Engineer-in-charge/Employer may order such investigation to be made which he considers appropriate.

When any pile is found defective the contractor shall replace the pile at his own cost. No extra time shall be allowed for such relocation of piles due to obstruction/failure during boring operation.

The contractor may carry out the piling work before excavation. In such an event, the portion of empty boring shall be filled with sand as per direction of Engineer-in-Charge/Employer. The cost of such empty boring and sand filling shall be included in the contractor’s rate.

3.12.32. SETTING OUT

The positions of the piles are to be set out by the contractor from cardinal points which will be provided by the Engineer-in-Charge the contractor shall be responsible for all errors in setting out and shall rectify the same at his expense, to the satisfaction of the Engineer-in-Charge.

3.12.33. SAFETY OF EXISTING STRUCTURES:

The contractor shall take every precaution to avoid damage or subsidence or collapse of the existing structures and services in the vicinity as a result of pile driving. All claims arising on account of the damages caused to the existing structures and services in the vicinity as a result of pile driving and during the process of boring shall be duly covered by the contractor by Insurance or borne by the contractor.

The design prepared by the engineer-in-charge is on the following basis:

Cast-in-situ bored reinforced concrete piles.
The accompanying drawings and bill of quantities have been accordingly prepared.

3.12.34. DESIGN AND CONCRETE QUALITY:

The Grade of Concrete of all types of pile shall be minimum M-30 unless otherwise mentioned. The cement content of piling work shall be minimum 400 kg/cum with ordinary Portland Cement. Water cement ratio and slump shall be as per I.S. Specification for relevant piling work. Maximum size of coarse aggregate shall be 20 mm.

Grading and other requirement of coarse and fine aggregate, water and concrete shall be as specified for reinforced cement concrete work in the relevant I.S. Codes.

3.12.35. CONTRACTOR’S RATE SHOULD INCLUDE:

The rates of the contractor for providing and laying cement concrete in various grades or proportion in the Schedule of quantities shall, apart from any other factors specified elsewhere in the tender documents, include for the following:

a. For all factors and method of work described in the specification.

b. For all materials, labour, tools and plants, scaffolding etc. mixing conveying and placing concrete in position, ramming, vibrating, trowelling, curing, providing necessary scaffolding and removing the same after the work is complete.

c. Unless otherwise specified in the Schedule of Quantities the cost for concrete items shall include for providing stays, struts, bolts, nuts and everything necessary to keep the form right, smoothening the surface to receive concrete as per detailed drawing, striking and stripping formwork after the concrete is cured, hacking the concrete surface, required to receiving plaster etc. Where shuttering is described as a separate item in the schedule of quantities the rate for shuttering shall be inclusive of all the works mentioned in this para apart from other factors mentioned in specification for form work and also elsewhere in this contract. Shuttering to curved structure will be measured and paid separately as detailed in Schedule of Quantities.

d. The reinforcement in case of reinforced concrete work be paid for separately unless otherwise stated in the particular items, but rate shall include for pouring concrete and packing around reinforcement.

e. Rates for concrete will be as per detailed drawings, shapes and size based on net structural sizes as drawing i.e. exclusive of plaster.

f. Rates for concrete items shall cover for any shape of a structural members like, columns, beams, facia, fins, louvers etc. and for cantilever beams, slabs etc. including curve structure.

g. Formation and treatment of construction joints, and expansion joints where water bars like copper strips, P.V.C. water bars or joints fillers like “Shalitex” are specified such materials shall be paid in separate rates.

h. Design of mixes where so required by specification in an approved government laboratory and on tests of materials and work required in the opinion of the Consulting Engineers and described in these specification.

i. Fixing all inserts and embeddings like pipes, plugs, forming roles etc. as per drawing to be paid separately.
j. Weigh-batching using a Mechanical Weigh batcher of a batching plant or where so specified for volumetric batching.

k. For taking out dowel bars, fan hooks, etc. through shuttering. However dowel bars, fan hooks etc. will be paid separately.

l. For forming drip moulds in chajja, sills, etc. where shown in the drawings or as directed.

m. For work at all levels.

n. In case where at the junctions of beams, columns, slabs, the composition of concrete mix of specified strength be different for columns, beams, and slab then in such cases only the richer concrete among those specified for in all these members shall be used at the junctions and rate quoted for columns, beams, and slabs, or any members entering such junctions shall allow for the same. Rate shall also cover for spill over of richer concrete in beams to natural angle of repose of wet concrete required from practical consideration while concreting the junctions.

4.FORMWORK

4.1. SCOPE OF WORK

The work covered by this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the supply and installation of form work for concreting, complete in strict accordance with this section of the specifications and subject to the terms and conditions of the Contract.

4.2. GENERAL CONSIDERATIONS

It shall be the responsibility of the Contractor to perform the work by well trained and experienced staff or by the Sub-Contractor who shall have enough number of well trained and experienced staff and coordinate with the other operations. However the Contractor shall be responsible for the quality of work performed by the Sub-Contractor as per the requirements of these specifications.

4.3. APPLICABLE CODES

- IS - 303 Specification for Plywood for general purposes
- IS - 4990 Specification for plywood for concrete shuttering work
- IS - 1629 Rules for grading of cut size of timber
- IS - 2750 Specification for steel scaffoldings.
- IS - 4014 Code of practice for steel tubular, scaffolding

4.4. MATERIAL SPECIFICATIONS

The Contractor shall use the following Form work materials for different purposes as stated below:

1. Timber.
   Form framing, sheathing, and shoring.

2. Plywood.
   From sheathing and panels.

3. Steel.
   - Heavy forms and falsework.
   - Column and joint forms.
- Permanent forms.
- Welding of Permanent forms.

4. Form Ties Anchors, and Hangers.
   Principle Use: For securing formwork against placing loads and pressures.

5. Coatings.
   Principle Use: Facilitate form removal.

   Principle Use: Form work support.

7. Steel Frame Shoring.
   Principle Use: Form work support and resisting side collapse.

Construction formwork with smooth faced plywood, steel or timber to produce smooth straight level and sharp profiles shall be used for the works. Panels to be in largest practicable sizes to reduce the number of joints.

Form material shall have strength adequate to withstand pressure of newly placed concrete without excessive and adjustable bow or deflection.

Factory fabricated adjustable length removable or snaps of metal forming ties, designed to prevent form deflection and to prevent spilling concrete surfaces on removal.

Ties shall be such that:

a) A portion remaining within the concrete shall be at least 38mm from the outer concrete surface.

b) That will not leave a hole larger than 25mm diameter on the concrete surface.

The form coating compound should not bond with, stain, not adversely effect concrete for required bond or adhesion and will not hamper the wetting of surface to be covered with water or curing compound.

All propping and centering shall be of adjustable steel supports (built-up sections of rolled steel) and tubular props to full height without joints, and with sufficient bracing to take into account the construction loads, namely full load of concrete with any live load and impact load likely to occur during concreting.

Steel shuttering used for concreting shall be sufficiently stiffened. The steel shuttering shall also be properly repaired before use and properly cleaned to avoid stains and defects in concreting.

4.5. DESIGN CRITERIA

4.5.1. Formwork system shall be executed and designed by a specialist qualified to the shapes, lines, forms and dimensions shown on drawings. The Contractor shall submit to the Engineer-in-charge/Client a method statement backed by design calculations. Required drawings and sketches shall be enclosed along with the statement for the proposed area to be taken up for working at a time. The number of repetitions expected, type of material used, etc shall be detailed therein.

4.5.2. Formwork shall start only after written approval from the Engineer-in-charge has been received. But this will not relieve the Contractor of its obligation to achieve its required line finish within accepted tolerance limits in terms of quality of works completed and safety. Neither will it diminish the Contractor’s responsibility for the satisfactory performance of formwork.

Basic points to be understood in designing of formwork are stated below:
i. Erected Formwork shall be watertight, shall conform to shape, lines, dimensions, verticality, rigid during placing, vibrating and configuring the concrete.

ii. Formwork system shall be of steel or timber or 12mm thick water resistant Ply board, and shall be continuous, straight and without any warping.

4.5.3. Design of formwork shall take into account:
1. Height of pour
2. Thickness of member
3. Rate of pour
4. Concrete slump
5. Texture of finish
6. Placing temperature
7. Concrete density
8. Construction joints
9. Wind load
10. Method of Discharge
11. Form work design shall have
12. Dimensional tolerance
13. De mountable without shock, disturbance or damage to concrete
14. All construction joints in beams and slabs shall be provided as shown in drawings.
15. Ties shall be provided where required
16. Cambers shall be provided where shown.
17. Props / supports of extra ceiling height shall be specially designed.

4.6. WORKMANSIP

4.6.1. Formwork shall be classified based on the ultimate finishes required of the concrete surface as
1. Textured or decorative finish
2. Fair-faced finish
3. Rough finish

4.6.2. The Contractor shall account for all material and labour to achieve the above finishes to the satisfaction of the Engineer-in-charge/ Client in his quoted price.

4.6.3. Guidelines for Good Workmanship

Following are a few points as guidelines for good workmanship in formwork and shall be accounted for in the contractor’s quoted price:

1. Erection of formwork may be from pre-moulded, pre-fabricated, pre-assembled plates or form reasonable enough to transport and erect at site to correct lines and levels as set at site.

2. Supports shall be firm and maintained in position by nails, cross bracing, tie-rods, locking bolts, nuts, etc. It shall be rigid and stiff so as to retain its shape during and after concreting.

3. Joints shall be water-tight and no cement slurry shall be allowed to pass out.

4. Pre-fabricated or site forms shall be assembled so as to deshutter without any jerk to the green concrete. For this double wedges shall be used. The wedges shall be nailed. The heads left with, allowing easy removal while deshuttering.

5. Pre-fabricated or site formwork shall be of sufficient thickness with supporting spans in both directions. These shall be standardized in size for easy replacement and universal use at site.
6. Props shall be of steel only. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be of proper steel plate or timber plank for equal distribution of load.

7. In case of multi-storied buildings, any upper floor shall be suitably supported on at least one floor below the same, or as approved by the Engineer-in-charge/Client.

8. Props shall be adequately cross-braced horizontally.

9. At the design and erection stage following additional points shall be considered and be incorporated into the setting
   a) Cleaning of openings prior to the start of concreting
   b) Pouring points shall avoid high drops and provide easy access to vibrating needles
   c) Surfaces shall be treated with suitable releasing oil or emulsion prior to the reinforcement laying. Such releasing oil shall be approved from the Engineer-in-charge/Client.
   d) Forms and adjacent surfaces should be thoroughly cleaned to receive concrete and should be free from debris.
   e) Construction joints should be located in a manner so as not to impair strength and appearance of structure.
   f) Without absolving the details on the above, the Contractor shall comply with instruction of the Engineer-in-charge/Client regarding designing, erection, execution, rotation, maintenance and reuse of formwork.

10. Following points shall be observed very carefully:
   a. Joints of formwork shall be watertight. It should be easy to check from the bottom and no light should be visible.
   b. Props shall be on solid base, plumbed, in straight line, braced horizontally and crosswise.
   c. Tie-bars, bracing and spacers in beams, walls and columns shall be at correct place/location and fully tight.
   d. Wedges shall be fully secured and nailed with heads left out for easy removal.
   e. All saw dust, dirt, shavings and any other unwanted material shall be cleaned and hosed out.
   f. Provision shall be made for watching formwork while concreting and any other platform needed for movement of workers without any disturbance to the reinforcement.
   g. Provision should be made for traffic on formwork and not to bear directly on reinforcing steel.
   h. Number of reuses shall be decided by the Engineer-in-charge/Client on examining the condition of formwork after each use. If during concreting any weakness develops or formwork shows any distress, the work shall be stopped and remedial action taken.

4.6.4. Finishing Formed Surfaces

The Contractor shall:
a. Smoothen concrete where fins and other projections have formed by moistening concrete surface within a day after forms have been removed and rubbing with carborundum stone until surface is of uniform color and texture within the projection limits.

b. If defects cannot be repaired to the satisfaction of the E-I-C, the defective concrete surface needs to be removed and repaired.

Surface defects includes colour and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, stain and tie holes.

The contractor shall:

i. Undercut voids larger than 25mm diameter and fill with fresh concrete after thoroughly wetting concrete surfaces.

ii. Fill small holes and irregularities using 2:1 (Portland cement to fine sand by volume) grout mixed with approved bonding admixture according to manufacturer’s specification.

iii. Blend standard Portland cement with white Portland cement if necessary so that final colour of dry grout matches adjacent surfaces.

iv. After applying grout to repair area, the same should be wiped with Hessian cloth to match adjacent texture and is to be kept within specified surface tolerances.

v. The concrete patch should be kept damp with fog spray for at least 36 hours.

4.7. MODES OF MEASUREMENTS

Formwork shall be measured as the area (in square metres) of shuttering in contact with the concrete including covers, angles, splays, mitres, bevels, etc. for which no special rate shall be allowed.

4.7.1. The quoted rate shall be applicable for all working conditions and at all heights and depths or lifts specified in the drawings. The rate shall include the cost of materials and labour for various operations involved, but not limited to the following:

4.7.2 Provision of formwork, its erection and treatment of the concrete surface immediately after removal of the formwork

4.7.3 Holes to be made in the formwork for inserting electrical conduits, piping for plumbing works, etc

4.7.4. Centering, bracing, tightening with bolts and nuts, staging, etc.

4.7.5. Splayed edges, notching, allowance for overlaps, centering, shuttering, strutting, bolting, nailing, welding, casing striking and removal.

4.7.6. Temporary openings in the forms for pouring concrete and removing rubbish.

4.7.7. Dressing with oil/approved emulsion to prevent adhesion of concrete with shuttering.

4.7.8. Raking or cutting.

4.7.9. Fixing inserts and openings at the correct line and level and at any stage to support the same at the directed height and place.

4.7.10. Platforms if any to check forms while concreting is in progress.

4.7.11. Filling and making joints watertight to the satisfaction of the Engineer-in-charge/Client.

4.7.12. Cleaning of the shuttering.

4.7.13. Cleaning the complete floor immediately on deshuttering complete to enable the start of next activity.

4.7.14. Cleaning and washing of the complete floor during and after concreting to avoid any damage to finished surface. It will be responsibility of the contractor to protect and retain all finished surfaces.
Should there be any latency due to concreting of upper floors or other construction activities within the said floor the Contractor shall be responsible to do all that is required to bring the finish back to the original or as specified in the Technical Specification/directed by the Engineer-in-charge/Client.

No payment shall be made for temporary formwork used in concreting nor for formwork required for joints or buttheads, in floors or elsewhere where such joints are to be covered later with concrete or mastic or other material.

4.8. TOLERANCES

The following shall be the maximum permissible tolerance :-

a. On general setting out dimensions upto 4 M in length a tolerance upto 3mm will be allowed.

b. On lengths of more than 4 M tolerance of not more than 5mm will be allowed.

c. On the cross sectional dimensions of columns, beams, slabs, faces, chajja, mullions, grills, fins, louvers and such other members, tolerance of more than 1mm will not be allowed.

d. The top surface of concrete floor slab will be within 6mm of the level and line shown on the drawings.

e. Columns and walls and other vertical members shall not be more than 6mm out of plumb in their full height or 1 in 1000.

f. If work is not carried out within the tolerance set out above in (a) to (e), the cost of all rectification measures of dismantling and reconstructing as decided by the Owner/Employer/Consulting Engineers/Consultant shall be borne by the contractor. In case of work dismantled, the same not be measured and paid for.

4.9. REMOVAL OF FORMWORK

Formwork shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork.

1. Formwork shall be removed carefully without jarring the concrete and curing of the concrete shall commence immediately. Sudden shocks / vibrations during removal of wedges shall be avoided. Where finished edges have re-entrant angles, formwork should be removed as early as possible to avoid shrinkage cracks.

1. Concrete surfaces to be exposed shall where required by the Engineer-in-charge/Client, be rubbed with carborundum stone to give a smooth and even finish.

2. Where concrete requires plastering or other finish later, the concrete surface shall be hacked as directed.

3. No extra charge will be allowed to the Contractor for such work.

4.10. MINIMUM TIME REQUIREMENTS

For precast moulds the stripping time shall be 24 hours.

Stripping time shall be in accordance to the provisions as laid in IS 456:2000.

Stripping of formwork within the time limits listed above is subject to successful crushing of cubes compressive strength results.
4.11. CLEANING AND OILING OF FORMS

The contractor shall ensure that the surface of the forms that will touch the concrete shall be free from encrustations of mortar, grout, or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire off-cuts and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the complete formwork and remove all traces of duct and debris before pouring of concrete. The temporary holes shall be closed thereafter.

The surface of the forms to be in contact with the concrete shall be coated with a reliable coating that will effectively prevent the adherence of concrete and will not stain the concrete surfaces. After each use, the surfaces of forms which have been in contact with concrete shall be cleaned of mortar and any other material sticking to them, then will be well wetted and treated with form oil approved by the Engineer-in-charge/Client.

The Contractor shall provide commercial form release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces.

4.12. OPENINGS / INSERTS

Contractor shall provide all required openings, pockets, inserts as detailed in drawings. The Contractor shall provide required material and labour for fixing and supporting during concreting. In its quoted price, it is imperative to consider that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved, i.e. shall be in correct line and level. After concreting the openings shall be secured against any accident by proper covering and guard rail, warning notice, lighting, etc for which no extra cost is payable to the Contractor.

5. REINFORCED STEEL WORK

5.1. SCOPE OF WORK

The work to be done under this section consists of furnishing, cutting, fabricating, bending, placing and tying steel reinforcement in concrete structures or elsewhere as shown on the drawings or directed by the engineer-in-charge. The scope of this section of the specifications as laid down herein.

5.2. APPLICABLE STANDARDS

<table>
<thead>
<tr>
<th>Specification Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS-432</td>
<td>Specification for Mild steel and medium tensile bars and hard drawn steel wire.</td>
</tr>
<tr>
<td>IS-1139</td>
<td>Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.</td>
</tr>
<tr>
<td>IS-1785</td>
<td>Specification for plain hard drawn steel wire for prestressed concrete.</td>
</tr>
<tr>
<td>IS-1786</td>
<td>Specification for cold twisted steel high strength deformed bars for concrete reinforcement.</td>
</tr>
<tr>
<td>IS-2080</td>
<td>Specification for high tensile steel bars used in prestressed concrete.</td>
</tr>
<tr>
<td>IS-2751</td>
<td>Code of practice for welding of mild steel structures are folded plates.</td>
</tr>
<tr>
<td>IS-2502</td>
<td>Code of practice for bending and fixing of bars for concrete reinforcement.</td>
</tr>
</tbody>
</table>
5.3. STEEL GRADES

Reinforcements for concrete may be from any of the “grades” of steel indicated below, conforming to the relevant Indian Standards and their latest amendments mentioned against each:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Conforming to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe 250</td>
<td>Mild Steel</td>
<td>IS 432 (Part I)</td>
</tr>
<tr>
<td>Fe 490</td>
<td>Hard drawn steel wire</td>
<td>IS 432 (Part II)</td>
</tr>
<tr>
<td>Fe 415</td>
<td>High strength deformed/ ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 500</td>
<td>High strength deformed / ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 550</td>
<td>High strength deformed / ribbed steel</td>
<td>IS 1786</td>
</tr>
</tbody>
</table>

Reinforcing steel may be any of the following types:

- Type I Plain round bars (PR)
- Type II Welded wire Fabrics (WWF)
- Type III Cold Twisted Deformed Bars/ Corrosion resistant bars. (CTD-R)
- Type IV Thermo-Mechanically Treated Ribbed bars (TMT)
- Type V Thermo-Mechanically Treated Ribbed Corrosion Resistant bars (Copper) Bearing (TMT-CR)

5.4. BIS CERTIFICATION

Material received at the Site shall have BIS Certification mark. Such bundle or coil containing the bars shall be suitably marked with BIS Certification mark. Bars shall also be marked to identify categories. This shall be done as per IS: 1387.

In case bars are without BIS Certification mark, the manufacturer shall give a certificate stating the process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark to which it applies, corresponding to the number or identification mark to be found on the material.

All reinforcements shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any other foreign deleterious material present on the surface. Cleaning should be done to the satisfaction of the Engineer-in-charge/ Client.

Each batch of steel brought to the Site shall be tested prior to use. Cost of all tests shall be borne by the Contractor.

Material acceptable as per IS Specifications will be allowed into the Project. All rejected material shall be removed from the Site by the Contractor within 30 days of its rejection. If the same is not done, the Engineer-in-charge/ Client can get work done by third party at the contractor’s risk and cost and shall impose a penalty of Rs 500 (Rupees Five Hundred only) per metric ton per day. This will be without any appeal.

5.5. STORAGE

Reinforcement bars received at the Site shall be stored on hard, concreted platform and clear of the ground to a minimum of 300 mm with the use of timber sleepers or any other means. Reinforcements shall be kept covered by tarpaulins or plastic to avoid excessive corrosion or any other contamination. It is advised to follow storage methods as described in IS: 4082. The Contractor shall comply with the instruction of the Engineer-in-charge/ Client on method of stacking of steel.

Reinforcement steel shall be stored in such a manner as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.
5.6. QUALITY ASSURANCE

5.6.1. Supervisory staff shall have qualification and experience in the above field.
5.6.2. Welders qualified and having approved certificates for welding shall be employed.

5.7. HANDLING

5.7.1. Bend test requirements shall conform to the following and shall be based on 1800 bends of full size bars around pins.

<table>
<thead>
<tr>
<th>Bar diameter (mm)</th>
<th>Pin diameter for test bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 12, 16</td>
<td>3.5 x bar dia</td>
</tr>
<tr>
<td>20, 22, 25</td>
<td>5.0 x bar dia</td>
</tr>
<tr>
<td>28, 30, 32</td>
<td>7.0 x bar dia</td>
</tr>
</tbody>
</table>

5.7.2. Spacers shall be of any of the following:

i. Wire
ii. Precast concrete
iii. Moulded plastic

Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete.

Precast concrete spacers shall be of the same mix as that of surrounding concrete.

5.7.3. Tying wire shall be of 18 G black annealed mild steel wire or other approved type double fold to tie the reinforcements.

5.7.4. Cover blocks shall be non-corrosive material such as plastic, but not wooden or broken bricks or stone. Specially made concrete blocks shall be used. Such cover blocks shall be cast from concrete and not from cement mortar; strength of these blocks shall be equal to the concrete in use.

5.7.5. Tying wire shall be of 18G black annealed mild steel wire or other approved type double fold to tie the reinforcements. It shall be face from rust, oil, paint, grease, loose mill seales or any other deleterious material undesirable for concrete or reinforcement or which may prevent adhesion of concrete to reinforcement.

5.8. UNIT WEIGHTS

Unit weights payable per meter shall be as follows:

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Weight (kg/m)</th>
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5.9. DETAILED METHODOLOGY

5.9.1. CUTTING AND BENDING

5.9.1.1. Flame cut and hot bending is absolutely forbidden.
5.9.1.2. Cutting and bending reinforcement to approved shop drawings and details shall be used.
5.9.1.3. Bars to be cold-bend, either mechanically or by hand, but to correct radius using proper tools, machine and platform and confirming to IS 2502-1963.
5.9.1.4. Re-bending should not be done without approval. In case of re-bending, care shall be taken that the rating of bend is not less than 4 x bar dia at construction joints for plain steel bars and 6 x bar dia for high strength bars.
5.9.1.5. Reinforcement projecting from concrete shall not be bent without approval.
5.9.1.6. Bar bending schedule to be submitted for approval to the Engineer-in-charge/Client prior to commencement of any cutting, bending and binding of steel at site.
5.9.1.7. Cracked end of bars shall not be used on this Project.
5.9.1.8. Bars should be inspected for visible defects such as cracks, brittleness, excessive rust, loose mills scale, etc.

5.9.2. WELDING

5.9.2.1. Reinforcement should not be welded unless authorized by the Engineer-in-charge/Client and recommended by the manufacturers.
5.9.2.2. Site welding shall be done with suitable safeguards and techniques.
5.9.2.3. Welding, if approved, may be used for:
   i. Lapping reinforcement in position
   ii. Fixing reinforcement to other steel members.
5.9.2.4. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a longer welded length is required divide into sections with the space between runs not less than 5 x bar diameters.
5.9.2.5. Welded joints:
   i. Shall not be made at bends in reinforcement.
   ii. Stagger joints in parallel bars of principal reinforcement unless otherwise approved.
   iii. The distance between staggered joints shall not be less than the end anchorage length joints.

5.9.3. MECHANICAL SPLICING

5.9.3.2. Used as indicated in structural drawings.
5.9.3.3. Engineer-in-charge has to approve mechanical splices before using it at site.

5.9.4. INSPECTION

5.9.4.1. Reinforcement placing should be checked by Engineer-in-charge or his representative.
5.9.4.2. Ensure that the Formwork to receive the reinforcement should be clean and free from debris.
5.9.4.3. Cracked end of bars shall be cut out.

5.9.5. ANCHORING

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by Engineer-in-charge.
In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the development length requirement is satisfied. Hooks shall normally be provided for plain bars in tension. Development length of the bars shall be determined as per relevant clauses of IS: 456 - 2000.
The anchorage length of straight bar in compression shall be equal to the Development length of the bars in compression as specified in relevant clause of IS: 456 - 2000.

5.9.6. **LAPPING OF BARS**

Laps shall be strictly as per the structural drawing or as directed by the Engineer-in-charge. For general guidance the following principles shall be followed as given in IS: 456 – 2000

5.9.6.1. As far as possible bars of the maximum length available shall be used.
5.9.6.2. Laps shown on drawings or otherwise specified by the engineer-in-charge will be based on the Contractor using bars of maximum length.
5.9.6.3. In case Contractor wishes to use bars of shorter length, laps shall be provided at the Contractor’s expense in the manner and the locations approved by the engineer-in-charge.
5.9.6.4. Splices shall be provided as far as possible away from the sections of maximum stress and shall be staggered.
5.9.6.5. Not more than half of the bars shall be spliced at a section
5.9.6.6. If more than half of the bars shall be spliced at a section, special case shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.
5.9.6.7. Lap splice shall not be used for bars having diameter larger than 36 mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be La (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2La or 30 times the diameter of the bar whichever is greater.
5.9.6.8. Lap length in compression shall be equal to the development length in compression calculated as described in relevant clause of IS: 456-2000 or as specified in the structural drawing but not less than 24 times the diameter of the bar.
5.9.6.9. Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.
5.9.6.10. When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wire of 0.90mm to 1.6mm diameter twisted together tightly.
5.9.6.11. As and when necessary welded laps shall be proved as specified by the engineer-in-charge.

5.9.8. **CONCRETE COVER**

5.9.7.1. Shall be in accordance with ISI: 456-2000 and as per the instructions in structural drawings.
Sizes of cover blocks should be stipulated as follows:

5.9.7.1.1. Footings, retaining walls and Similar members in contact with earth but not cast against earth - 50 mm
5.9.7.1.2. Slabs - 20 mm
5.9.7.1.3. Walls, ribs - 20 mm
5.9.7.1.4. Beams:
   - For main bars - Min.25 mm or dia. of the bar
   - For stirrups - 15 mm
5.9.7.1.5. Columns
   - Columns less than 20 cms - 40 mm
   - 25 mm
5.9.7.1.6. Water tanks:
   - In contact with water - 40 mm
   - In contact with air - 20 mm
5.9.7.1.7. Walls in contact with water / Earth - 40mm

5.10. **PRECAUTIONARY MEASURES**

5.10.1. Do not insert bars into placed concrete.
5.10.2. Do not damage forms and form linings, if any when fixing reinforcement.
5.10.3 Necessary supports are to be provided to maintain reinforcement in its correct position.

5.11. ADJUSTMENT AND CLEANING

5.11.1. Reinforcement prior to and during placing concrete with particular attention to the top reinforcement in cantilever sections should be properly checked.

5.11.2. Reinforcement should be clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement, concrete or the bond between the two.

5.11.3. The projecting reinforcement should be protected from weather where the rust staining of exposed concrete surfaces may occur.

6. STRUCTURAL STEEL WORKS

6.1. GENERAL DESCRIPTION

The contractor shall furnish all materials, labor operation, equipment, tools and plant and incidentals necessary and required for the completion of all metal work in connection items of metal work as called for in the drawings. The drawing and specifications cover the major requirements only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein but which are necessary to make a complete installation shall be a part of the contract.

6.2. APPLICABLE STANDARDS

IS-226-1975 - Structural Steel (standard quality)(fifth revision)
IS-456-1978 - Code of practice for plain and reinforced Concrete (third revision)
IS-696-1972 - Code of practice for general engineering drawings (second revision)
IS-786-1967 (supplement) SI supplement to Indian standard conversion factors and conversion tables (first revision)
IS-812-1957 - Glossary of terms relating to welding and cutting of Metals

IS-813-1961 - Scheme of symbols for welding

IS-814 - Covered electrodes for metal arc welding of structural steels: 814 (part -1)-1974 part-1 for welding products other than sheets (fourth revision)
IS-816-1969 - Code of practice for use of metal arc welding for general construction in mild steel (first revision)
IS-817-1966 - Code of practice for training and testing of metal arc welders (revision)
IS-819-1957 - Code of practice for resistance spot welding for light assemblies in mild steel
IS-875-1964 - Code of practice for structural safety of buildings: Loading standards (revision)
IS-919-1963 - Recommendations for limits and fits for engineering (revision)
IS-961-1975 - Structural steel (high tensile) (second revision)
IS-962-1967 - Code of practice for architectural and building drawings (first revision)
IS-1024-1979 - Code of practice for use of welding in bridges and structures subject to dynamic loading (first revision)
IS-1030-1982 - Carbon steel castings for general engineering purposes (second revision)
IS-1148-1973 - Hot-rolled steel rivet bars (up to 40 mm diameter) for structural purposes (second revision)
IS-1149-1982 - High tensile steel rivet bars for structural purposes
IS-1261-1959 - Code of practice for seam welding in mild steel
6.3. PRODUCTS

6.3.1. MATERIALS

1. Structural steel members.
2. Structural tubing.
3. Welding materials.
4. Primer.
5. Shear studs.

All metal materials shall be free from defects impairing strength, durability and appearance and they shall have structural properties that comply fully with the standards. All ferrous metal shall be free from rust, scale and other defects. All non-ferrous metal shall have uniform finished surfaces, machined and buffed, free from defects. All sections shall conform accurately to sizes and shapes required.

6.3.2. FABRICATION

6.3.2.1. Structural steel members should be fabricated in accordance with IS Specifications 800 section V and approved shop drawings.

6.3.2.2. Defective material used shall be replaced by the contractor.

6.3.2.3. Fabricated items delivered at site shall be suitably protected from any damages.
6.3.3. FINISH

Structural steel members should be cleaned, prepared and shopped and primed. Surfaces to be field welded or in contact with concrete should not be primed.

6.4. EXECUTION

6.4.1. Structural steel should in accordance with IS Specifications.
6.4.2. Provision for erection loads and for sufficient temporary bracing should be made to maintain the structure in proper plumb and in true alignment until completion of erection and installation of permanent bracing.
6.4.3. Structural members should not be field cut or altered without approval of engineer-in-charge.
6.4.4. Members shall be cut mechanically by saw or shear or by oxy acetylene flame and not by electric metal arc. Cut edges shall be ground as per IS 823. Cutting tolerances shall be:
   - Members connected at bolt ends: ±1 mm. and other members: ± 3 mm.
6.4.5. All bolt holes shall be drilled and to the sizes specified in drawings.
6.4.6. Tolerance for spacing between two holes: ±1 mm.
6.4.7. Tolerance between two perpendiculars of any oval holes: ± 1 mm.
6.4.8. Bolt holes for field joints shall be drilled in the shop to the required diameter and tested.

6.4. PREPARATION OF MEMBERS OF WELDING

6.5.1. Proper jigs and fixtures shall be used to ensure correct positioning of structural members during assembly.
6.5.2. Sharp edges, rusting of cutting edges, notches, irregularities, and fissures due to faulty cutting shall be chipped and ground.
6.5.3. Edge preparation for welding shall be done properly taking care of cleaning, providing dry surface, removing grease, dust or dirt, foreign matter, etc.
6.5.4. Finished dimensions of structure shall be ensured after taking into account the shrinkage and distortions during welding.

6.6. WELDING

PERSONNEL

Welders shall be fully trained, experienced and certified by the recognized welding institutes. Welders' qualification tests shall be as per IS 823 and approved by engineer-in-charge.

EXECUTION

(a) Welding shall be done in accordance with IS 823.
(b) Welding parts shall be marked with welders' identification.
(c) The welded parts, electrode wires should be against wind and rain.
(d) Discontinued seams shall be melted before resuming welding operation.
(e) Welding seams shall be cooled slowly and not by any other quick methods.
(f) Before welding a second layer over the existing layer of weld, the layer shall be cleaned metal bright by light chipping and wire brushing.
(g) Execution shall proceed in strict compliance with section 2/7 safety procedures.

APPROVAL

(a) Welded parts shall not have any deformations.
(b) Welded joints should compensate for contraction due to welding.
(c) Defective welds must be rectified.
(d) Weld seams shall correspond to design shapes and dimensions.
(e) Weld seams shall not have cracks, fusion, under cuts, rough surfaces, burns, blowholes, and incomplete penetration.

6.7. BOLTING

6.7.1. MATERIAL
A) Bolts, nuts shall be in accordance with IS 1367 and tested as per IS 1608.
B) Washers shall be as per IS 2016.

6.7.2. PREPARATION
(a) Members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.
(b) All sharp edges, shavings, rust, dirt, etc. shall be removed before assembly.
(c) Before assembling the contacting surfaces of the members shall be cleaned and given a coat of primer.
(d) The assembling shall be done temporarily and checked for co-axiality of the holes after which the assembly shall be finally bolted.

6.7.3. EXECUTION
1. Bolts shall be fixed after all the defects have been rectified and approved by engineer-in-charge.
2. Bolts shall be tightened form the center of joint towards the edge.

6.7.4. IDENTIFICATION
1. Structural members prior to dispatch for erection shall be marked with a weather proof light colored paint. The size and thickness of members shall be so chosen as to facilitate easy identification.
2. Structural members small in size shall be bundled or crated and shall be marked with metal tags for bundles and painted on crates for identification with particulars of the bundle/crate size, weight, etc.

6.8. PAINTING

6.8.1. PREPARATION
(a) Surface to receive primer coat shall be sand blasted/ wire brushed, free of dust, oil, rust etc.
(b) Surfaces not accessible to painting shall be filled with approved type of oil and putty.
(c) Surface shall be completely dry.
(d) Surfaces where water or aggressive agents may accumulate during transportation, storage, erection and operation shall be filled with putty and provided with drainage holes.
(e) Structural steel members and welds need to be inspected and approved by E-I-C.
(f) After satisfying the above criteria the surfaces are to be provided with one coat of red oxide/zinc chromate primer to the satisfaction of engineer-in-charge before the material is dispatched for erection.

6.8.2. The following areas are not to be primed.
(a) Surfaces to receive weld at site.
(b) Surfaces bearing markings.
(c) Surfaces shall receive a coat of hot oil or any approved resistant lubricant only.
(d) To give a coat of cement wash for any members either embedded or in contact with concrete.
(e) To give a bituminous coat for members in contact with ground, gravel, brickwork and moistures.
(f) Contractor to give a further coat of red oxide paint after erection and placing in position of the assembly if called for by the engineer-in-charge.

6.8.3 FIELD ERECTION
(a) Approvals of foundation, column pedestals or other related structure on which the structural steel members are to be erected is a prior necessity.
(b) To get approvals of the members receiving structural steel members regarding their levels, dimensions, alignments and verticality well in advance.
(c) To carry out any minor discrepancies at no additional cost.
(d) To get approvals of pockets, bolt locations, levels of base plates etc. before erection.
(e) Erection to commence after satisfying the above conditions.
(f) Erection to be done in an organized way so that any individual member is not subjected to instability during the erection time.
(g) Precautionary measures to be taken during erection of trusses, purlins and other steel members by providing proper bracing.
(h) Faulty erections done without caring for safety of members and of personal shall be made good at no additional cost.
(i) Contractor is not relieved of his responsibilities, guarantees even after the engineer-in-charge approves the fabrication, erection, etc. at any stage of work.
(j) Contractor is solely responsible for the correctness accuracy and quality of the fabrication erection and final approvals to be obtained by the engineer-in-charge.

7. BRICK MASONRY

7.1. GENERAL.

Brick Masonry shall consist of all work required in connection with constructing brick masonry at locations shown on drawings including, but not limited to, furnishing brick, portland cement and sand for mortar and all other materials, and mixing, placing brick masonry as per bill of quantities.

7.2. MATERIALS.

i) All portland cement for mortar and plaster work shall be furnished by the Contractor and shall conform to the applicable requirements specified in the section- 3.5.1.

ii) All sand for mortar and plaster work shall be furnished by the Contractor and shall conform to the applicable requirements for sand specified in the section- 3.5.2.

iii) All water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities, and will be tested and approved by the ENGINEER-IN-CHARGE as per the guidelines of IS: 456.

7.2.1. MORTAR.

i) MIX: Mortar for all brick masonry, except where otherwise directed by the ENGINEER-IN-CHARGE, shall consist of one part cement to six parts of damp loose mortar sand by volume for brickwork 230mm and above. For brick piers, half brick walls, honey-combed brickwork and hollow (cavity) walls, the mortar mix shall consist of one part cement and four parts of sand. Quantity of water shall be just sufficient enough to produce proper consistency for the intended use. Where directed and approved by the ENGINEER-IN-CHARGE, hydrated lime putty, shall be added to the mortar for increased workability. The putty shall, however, not exceed 25% by volume of the dry cement.

ii) Methods and equipment used for mixing mortar shall be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the ENGINEER-IN-CHARGE. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of the water to the mix shall be wasted. Re-tampering of mortar will not be allowed. The mixers shall be thoroughly cleaned and washed at the end of each day's work.
7.2.2. BRICK.

i) All bricks shall be of first class quality made from good brick earth, free from saline deposits and shall be sand moulded. They shall be thoroughly burnt without being vitrified, shall be regular, uniform in shape and size with sharp and square edges parallel faces and of deep red or copper colour. First class bricks shall be homogeneous in texture and emit a clear ringing sound when struck, and shall be free from flaws, cracks, chips, stones and nodules of lime. First class brick in an oven dried condition shall not absorb more than 1/5 of its weight of water when immersed for one hour in water at 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class bricks shall be 15 N/ sq. mm. and shall no result shall fall below 10 N/mm sq. The bricks in general shall conform to the requirements of IS:1077.

ii) All bricks shall be manufactured by the Trench Kiln method or other standard methods approved by the ENGINEER-IN-CHARGE. The earth used in manufacturing bricks shall be carefully selected and shall be free from objectionable quantities of lime, gravel coarse sand, roots, or other organic matter. Salts shall not exceed 0.3% and calcium carbonate shall not exceed 2.0%.

iii) The moulds used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently larger than the size of the bricks being manufactured to allow for shrinkage in drying and burning. The size ready for use shall be 9" by 4 3/8" by 2 3/4" (229X 112X 70mm) and shall weigh between 3.2 to 4.2 Kilograms. All bricks shall have a "Frog" 1/4" deep on one face.

7.3. PLACING.

i) All bricks shall be immersed in water for 24 hours before being put into work. The contractor must make tanks of sufficient capacity (at his own cost) for the purpose of soaking. The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Brick shall not be placed during rains sufficiently heavy or prolonged to wash the mortar from the brick. Mortar which becomes diluted by rain shall be removed and replaced before continuing with the work. All bricks to be used in brick masonry shall be moistened with water for three to four hours before they are used. The chosen method of wetting shall ensure that all bricks are thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

ii) Bricks shall be laid "Frog" upward with mortar joints and in English bond as shown on the drawings or as directed by the ENGINEER-IN-CHARGE. Both bed and vertical joints shall be 6mm in thickness completely filled with cement mortar as specified herein, and each brick shall be bedded by firmly tapping with the handle of the trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight with the edge of a trowel and a straight edge. All anchors and similar work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and repointed.

iii) The exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the brick work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joints and vertical joints shall be struck with a V notch. Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

iv) REINFORCED BRICKWORK:
All half brickwork shall be reinforced with 2 no. 6.mm dia M.S. round bars or equivalent reinforcement at every fourth course. The reinforcement cleaned of rust and loose flakes with a wire brush, shall be embedded thoroughly in cement mortar at every fourth course. It shall be cast in or securely fixed to adjoining columns or walls, in a manner approved by the ENGINEER-IN-CHARGE.
v) EXPOSED BRICK WORK:
Where exposed brick work is specified the usual specification for 'Brick Work' as mentioned above will be applicable for 'Exposed Brick Work', but in addition specially selected brick shall be used for facing, ensuring regular and clean faces of uniform colour. No bricks which are broken chipped, wrinkled or which have irregular edges of corners shall be used. Depending on the quality of bricks and if instructed by the Owner/ Employer/ Consulting Engineers the exposed faces of every bricks shall be rubbed before laying without extra charge. Wooden fillets 10 mm thick and 10 mm wide shall be placed at the edge of joints so that the mortar comes on the surface of the bricks and a regular thickness of joints is maintained. The surface shall be rubbed down with brush on bricks if necessary, and thoroughly washed. No mortar shall be allowed to stick to the surface, which shall be left clean to the Owner/ Employer's/ Consulting Engineers's satisfaction with all joints even and true to straight line. Double scaffolding shall be used for exposed brick work, if necessary.

7.4. CURING AND REPAIR.

i) All brick masonry shall be water cured and shall be kept wet for least seven days by an approved method which will keep all surfaces continuously wet. Water used for curing shall meet the requirements of these specifications for water used in the manufacture of bricks.

ii) If, after the completion of any brick masonry work, the brick is not in alignment or level, or does not conform to the lines and grades shown on the drawings, or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the ENGINEER-IN-CHARGE grants permission, in writing to patch or replace the defective area.

7.5. SCAFFOLDING.

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expenses. Scaffolding which is unsafe in the opinion of the ENGINEER-IN-CHARGE shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damaged, masonry from scaffolding or from any other objection shall be repaired by the Contractor at his own cost.

7.6. TOLERANCES.

The brick work shall be erected plumb and true to line at level with the maximum variation in any storey height of any length of wall being 1 mm in one meter. The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 3mm.

7.7. MEASUREMENT.

Measurement of acceptable completed works of brick masonry will be made on the basis of cubic metres for 200mm thick brickwork or above and Square metres for 75mm upto 125mm thick brickwork provided and installed in position as shown on the drawing or as directed by the ENGINEER-IN-CHARGE.

7.8. RATES TO INCLUDE:

Apart from other factors mentioned elsewhere in this contract, the rates for items of brick work shall also include for the following:

a) All labour, materials, use of tools, equipment and other items, incidental to the satisfactory completion of brick masonry at all heights and levels.
b) Erecting and removing of all scaffolding, ladders and plant required for the execution of the work to the height and depths and shapes as shown on the plan or as ordered by the Owner/ Employer/ Consulting Engineers/ Consultant including extra labour and materials for using cut bricks in the construction of wall of varying thickness other than one brick, one and half brick, half brick and brick on edge walls as per drawings.

c) Constructing brick work to lines, levels, batters, pillars, curve, projection, cutting, toothing etc. in strict conformity with the drawings and to any position or shape, to any heights or levels including raking out joints and housing frames, fixtures etc.

d) Necessary charges of outside scaffolding work for construction of external brick work form outside to have fair-face on external surface.

e) Curing brick work.

f) Extra labour for bonding brick work to R.C. works as specified.

g) Removing of all stains and adhering mortar lumps on the brick work surface.

h) Cost of reinforcement in half brick walls and brick on edge walls.

i) Raking out joints for receiving plaster as specified.

8.0 PLASTERING

8.1 SCAFFOLDING
Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

8.2 PREPARATION OF SURFACE
All holes in brick work and junction between concrete & brick work shall be properly filled in advance. Joints in brick work shall be racked about 10mm and concrete surface hacked to provide the grip to the plaster. Projecting burns of mortar formed due to gaps at joints in shuttering shall be removed.

The surface shall be scrubbed clean with wire brush/ coir brush to remove dirt, dust etc. and the surface thoroughly washed with clean water to remove efflorescence grease and oil etc. and shall be kept wet for a minimum of six hours before application of plaster but there should not be any free standing water on the surface.
All plaster work shall be kept continuously wet for seven days

8.3 ORDINARY CEMENT PLASTER
The preparation of surface shall be as stated above. The thickness and proportion of plaster shall be specified in the schedule of items.

The mortar shall be applied evenly with force on the surface to be plastered. The mortar surface shall be finished at once by rubbed over with a trowel till the cement appears on the surface, all corners. Angles and junctions shall be truly vertical & horizontal as the case may be neatly finished. Rounding of corners and junctions where required shall be done without extra charge. The mortar shall adhere to the surface intimately when set and there should not be hollow sound when struck.
8.4 SAND FACED PLASTER
The surface shall be prepared as above. The cast of cement mortar in proportion of 1:4 or as specified in the schedule of works shall be applied uniformly all over the surface to the specified thickness and finished true to level and line and keys shall be formed on the surface.

The surface shall be kept moist till the finishing coat is applied. The finishing coat shall be applied a day or two after. The proportion of mortar for finishing coat shall be one part of cement and three parts of selected, well graded and washed sand & it shall be applied in a uniform thickness of 6 mm (1/4"). The surface shall be tapped to uniform grained texture by using sponge pads as directed. Curing shall start after 24 hours and the surface kept wet for seven days.

8.5 ROUGH CAST PLASTER
Except for the finishing coat, the surface shall have base coat of plaster applied, prepared finishing coat of mortar shall be in proportion of one part of cement and one part of specially selected and graded sand and one part of gravel of 3 to 6 mm size. It shall be flung upon the first coat with large trowel size to form an even and decorative coat. The work shall generally conform to clause 16.5 of I.S. 1661-1960 and the thickness of the coat shall be about 12 mm (1/2"). It shall be cured for seven days.

8.6 RATES TO INCLUDE:
Apart from other factors mentioned elsewhere in the contract rates for the item of plaster shall include for the following:

i) Erecting, dismantling and removing the scaffolding.

ii) Preparing the surface to receive the plaster.

i) Providing cement plaster of the specified average thickness.

ii) All labour, materials, use of tools and equipment to complete the plastering as per specification.

iii) Curing for 7 days.

iv) Any moulding work if shown on the drawings or as specified unless separately provided in the tender.

9.0. WATER PROOFING

9.1 WATER PROOFING TREATMENT:
Waterproofing specifications given hereunder or in the BOQ are indicative only. Acceptance of any other alternative specifications will be subject to approval by the E-I-C/ Consultant.
The tenderer further to note that a guarantee of 10 (ten) years for satisfactory performance on a Rs. 50.00 non-judicial stamp paper has to be furnished to the Owner/ Employer as per Proforma approved by the Consultant.

9.2 UNDERGROUND WATER TANK:
The entire inner surface of base slab and side walls (external and internal) of water tank shall be cleaned properly to be free from dust, oil, loose particles etc. 15mm thick cement sand plaster (1:3) should be added with water proofing compound @ 3% by weight of cement over which a layer of Tape crete is to be applied. The surface to which Tape crete should be allowed should
be kept moist before it's application. The Tape crete with cement slurry should be applied both horizontally on the surface with a 100mm wide brush. Application of one coat of Tape crete will be deemed to be completed when it is applied both horizontally and vertically. The same will be allowed to dry for 24 hours and the application of second coat will be made thereafter in a similar manner. 2 coats of application of Tape crete should be considered as application of one layer. This should be followed by 15 mm thick (1:3) cement plaster with waterproofing compound @ 3% by weight of cement and finish it with neat cement punning. Neat cement punning will be done only on the inner walls and base slab.

9.3 ROOF TREATMENT

The roof waterproofing treatment comprises of addition of waterproof compound during casting of R.C.C. roof slab (above G+IV level), waterproof plastered surface and waterproof cement concrete (1:2:4) as laid in slope.

a) Preparation of sub-grade: - The surface of the roof slab should be cleaned properly by chipping off any loose mortar and reasonably leveled. The surface should be cleaned, dust free and dry. Any pocket or honeycomb in concrete surface must be filled properly with (1:1.5:3) concrete and if necessary pressure grouting to be done as per direction of the E.I.C. by the Agency at his own cost.

b) Plastering: - After preparation of sub-grade apply 15mm thick cement plaster (1:3) mixed with waterproofing compound @ 3% by weight of cement.

c) Chemical Treatment (Tape crete): - The chemical waterproofing treatment is in two operation. First one coat of tape crete is applied and after paint becomes dry then second coat of tape crete is to be applied.

d) Guarantee of the Chemical Treatment: The contractor must produce guarantee certification.

e) Cement concrete: - When the Chemical paint becomes dry plain cement concrete (1:2:4) with graded stone chips (20 mm down) mixed with waterproofing compound @ 3% by weight of cement is to be laid in panels. The panels should not be more than 10 sqm. with maximum length 3.0 m. The concrete should be laid with every precaution, so that there is no damage to the waterproofing Tape crete paint. Cement concrete must be laid with proper scope as per roof drainage drawing, thoroughly beaten in both direction so that it is well compacted. The thickness of concrete should not be less than 35 mm at the minimum point. Dry cement is to be spread when the concrete is still green and finished smooth with trowel. The rate should include preparation of water channels, goondy, mouth of rain water pipe etc complete.

9.4 WATER PROOFING TREATMENT TO THE BASEMENT

All R.C.C castings of Basement walls, floor and Basement roof should be done with waterproof compound @3% by weight of cement.
a) HORIZONTAL SURFACE

i) Basement Floor: After laying of P.C.C, the waterproofing operation will be made sequentially as under:

After laying of 75mm thick P.C.C (1:4:8) over 600mm thick sand filling, a course of A.P.P. (Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane is to be laid as per manufacturer's specification (as detailed in the schedule of work) followed by a layer of 15mm. thick Cement Plaster(1:3) using water proofing compound @ 3% by weight of cement before casting. The R.C.C. Slab should be casted with water proofing compound @ 3% by weight of cement. Over the R.C.C. Slab, sand filling to be done followed by one layer of P.C.C. and then a layer of Tape crete (2 coats) is to be applied on the P.C.C. followed by 35mm. thick artificial stone flooring having chequered finish and laid in panel.

d) Basement roof: After casting of R.C.C slab, the waterproofing operation will commence. The stepwise sequence will be as under:

a) 1st course: Applying 10mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) 2nd course: Providing and laying A.P.P.(Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane.

c) 3rd course: Applying 15mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) VERTICAL WALL OF BASEMENT:

a) External surface:

(i) After removal of shuttering, surface of the walls should be thoroughly scrubbed and cleaned. The wall surface is to be prepared for application of tape crete as per manufacturer’s specification. The surface should be properly saturated prior to the application of tape crete. A layer of 15mm cement plaster 1:3 containing integral waterproofing compound to be applied there after.

ii) Providing and laying A.P.P.(Atactic Polypropylene Polymer) modified prefabricated fine layer, 3mm thick water proofing membrane.

iii) Applying 15mm thick cement plaster (1:3) mixed with water proofing compound @ 3% by weight of cement.

b) Internal surface: After removal of shuttering, surface of the walls should be thoroughly scrubbed and cleaned for application of one layer of Tapecrete, over which a layer of 15mm thick cement plaster (1:3) containing integral waterproofing compound is to be applied.
9.5 WATER PROOFING TREATMENT TO SUNKEN FLOOR OF TOILET, KITCHEN AND PANTRY.

Providing and laying water proofing treatment to vertical and horizontal surface of depressed portion of WC, kitchen and the like consisting of:

(i) **1st course:** Applying cement slurry @ 4.4 kg/ sqm mixed with water proofing compound conforming to IS 2645 in recommended proportion including rounding of junction of vertical and horizontal surface.

(ii) **2nd course:** Applying 20 mm cement plaster 1:3 (1cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding of junction of vertical and horizontal surface.

(iii) **3rd course:** Applying blown or residual bitumen applied hot at 1.7 kg/ sqm area.

(iv) **4th course:** Applying 400 micron thick PVC sheet (overlapped at joint of PVC sheet should be 100mm wide and pasted to each other with bitumen @ 1.7Kg / SQM).

9.6 WATER PROOFING TREATMENT TO OPEN TERRACE GARDEN AND PLANTERS

Water proofing treatment to open terrace gardens should be done in a similar manner like the Basement roof.

N.B. : The surfaces where water proofing treatment is required to be done, should become water tight in true sense after application of the water proofing treatment. Any defect in this regard will have to be rectified as per direction of E.I.C by the Agency at his own cost i.e. no claim for payment in this regard will be entertained.

Rectification by chemical injection grouting may be adopted as stated below subject to written approval of EIC/Consultant, solely to be done at the cost of the agency.

Chemical injection grouting is to be carried out by fixing nozzles and through mechanical pump at an optimum pressure of 3.0 to 4.0 Kg/sq cm. Grouting at defective zones shall be done with Acrylic based waterproofing chemical mixed with neat cement slurry. The viscosity of cement slurry is important - thinner the slurry, deeper the penetration into the fine capillaries. For honeycombed areas of finished concrete, thicker slurry is to be used. All construction joints, honey combs, cold joints, after casting shall be treated by hacking open the affected area to sound concrete, fixing nozzles and grouting the same, under pressure with cement slurry mixed with plasticizer, and non shrink additive.
10.0 FLOORING, SKIRTING & CLADDING WORK:

10.1 CEMENT CONCRETE FLOORING:

a) Cement concrete is to be composed of 1: 2: 4 (1 part cement : 2 parts coarse sand and 4 parts 12 mm down stone chips) for the bottom layer 20 mm and 30 mm for 25 mm and 35 mm finished flooring respectively. The topping is to be 6 mm thick in all cases and consist of neat cement paste of uniform colour.

b) In case of dado and skirting the total thickness is to be 20 mm of which the bottom layer is to be 15 mm and the topping 6 mm. In all cases, both the layers are to be laid simultaneously in one operation, but the mixing may be made in two lots.

c) Before laying concrete surfaces are to be chipped off, roughened and cleaned and thoroughly wetted and grouted in neat cement.

d) The floor shall be bounded and flooded with water for a period of two weeks after laying.

e) The treads and risers of staircase shall be finished as like the floors.

f) Specified polishing is to be done by expert trained labour only when the surface is matured, by rubbing with carborandum stone by machine, to the satisfaction of the authorities. The polishing shall not be done before proper maturing, which takes at least eight weeks.

g) Where desired all internal angles are to be covered.

h) Where coloured artificial stone is specified, the proportion of pigment shall be one part of pigment to three parts of “Portland” cement. The pigment must be of approved manufacture and tints to be uniform.

i) Any cracks, rust, disfiguration or discolouring of surfaces will have to be made good without extra charge to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ E-I-C.

j) Flooring of specified thickness shall be laid in alternative panels as directed by the Consulting Engineers/ Consultant/ Owner/ E-I-C. The panels shall be of uniform size not exceeding 3 sqm. with a minimum length of 1800 mm and below in any direction with glass divisional strips penetrating the entire thickness of the surfacing. The rates quoted should include all the close operations including cost of glass strips.

10.2 ARTIFICIAL STONE FLOORING:

a) Grey and coloured stone is to be composed of two parts of fine stone chips, 6 mm down, washed and screened, to one part of cement for the bottom layer, which must have a minimum thickness of 16 mm and 26 mm for 25 mm and 35 mm finished flooring, respectively. The topping is to be 10 mm thick in all cases and to consist of clean and
fine stone dust and cement (2:1). Sufficient skin thickness is to be kept for polishing. The base course is to be covered with a thick layer of neat cement grout, well brushed in, to be laid, well tamped with screed bars lightly floated to the required level and slopes. As soon as initial set takes place the surface shall be trowelled to a smooth finish, or broom finish, as instructed. Sprinkling of dry cement or mixture of dry cement and sand, on the surface should be avoided.

b) In the case of dado and skirting, the total thickness is to be 20 mm of which the bottom layer is to be 14 mm and topping 8 mm. In all cases, both the layers are to laid simultaneously in one operation, but the mixing be made in two lots.

c) The floor shall be bounded and flooded with water for a period of two weeks after laying.

d) The treads and risers of staircase shall be finished as like the floors and with a wooden float and have a small quantity carborandum sprinkled evenly on the surface to provide anti-slip finish.

e) Where specified, polishing is to be done by expert trained labour, only when the surface is matured, by rubbing down with carborandum by machine, to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ Employer. The polishing shall not be done before proper maturing, which takes at least eight weeks.

f) When desired, all internal angles are to be coved.

g) Where coloured artificial stone is specified, the proportion of pigment shall be one part of pigment to three parts of “Portland” cement. The pigment must be of approved manufacture and tints to be uniform.

h) Any cracks, rust, disfiguration or discolouring of surfaces will have to be made good without extra charge to the satisfaction of the Consulting Engineers/ Consultant/ Owner/ Employer.

i) When cast-in-situ, the flooring is to be carried out in panels not exceeding 7.0 sqm. with maximum length of 3 M, expansion joints separated by aluminium/ glass trips penetrating the entire thickness of the surfacing. Rates quoted are to be inclusive of the cost of dividing strips.

10.3 IRONITE HARDNER:

a) Where desired, ironite hardner is to be laid on top of cement concrete floor, the ironite topping must not be less than 12 mm thick.

b) This shall consist of 12 mm thick layer of mix 1:2 (1 part ironite mixture and 2 parts hard stone grit 6 mm ad sown gauge) by volume the ironite mixture is to be composed of 1 ironite : 4 cement by weight. Ironite shall be dry mixed thoroughly with cement on a
clean dry pucca platform and then stone grit added and mixed. The mix is prepared by adding water in the usual manner.

c) The mix is then laid to the desired thickness, when the initial set takes place, the surface is to be trowelled to a smooth finish with a steel trowel. The finished flooring is then kept wet for at least seven days by means of wet sacks or by other suitable materials to the approval of the Consulting Engineers/ Consultant/ Owner/ E-I-C. Sprinkling of neat cement over the flooring during the process of final trowelling is prohibited.

10.4 CAST- IN- SITU MOSAIC FLOORING, DADO AND SKIRTING

FLOORING :

a) Preparation of sub-grade :

The surface of the base slab shall be struck off reasonably true at a level (average 30 mm or other wise) required to suit the thickness of floor finish as mentioned in the schedule of quantities below the required finished level. Before laying floor concrete, the sub-grade shall be properly cleaned and trimmed to give required thickness of floor and neat cement slurry applied to give proper bond of floor with the sub-grade.

b) Flooring composition (In-situ) :

This will consist of two layers, the bottom one called the ‘under coat’ and the top one called the ‘top coat’. The bottom coat shall be 26 mm thick (average) and the top coat shall be 9 mm thick (finished). The total finished thickness shall be 35 mm (average) unless otherwise stated in the Schedule of Quantities.

i) Undercoat :- The concrete for the undercoat shall be mixed in the proportion of one part Portland cement 2 parts of sand to 4 parts of fine stone chips mixed with not less than 25 litres (5 – gallons) of water per bag of Portland cement.

ii) Glass Strips :- While laying the undercoat, glass strips of about 3 mm thick and width to suit thickness as separators shall be provided to from approved panels unless otherwise specified in Schedule of Quantities.

The area of each panel in the flooring shall not exceed 3 sqm. or as directed, the longest side of any panel not exceeding 1.5 metre. The cost of providing glass strips in the flooring shall be included in the rate quoted for mosaic flooring.

iii) Top Coat :- The grading, proportion and colour of the marble chips shall be got approved from the Owner/ Employer/ Consulting Engineers after preparing a few
samples of cast-in-situ mosaic flooring. The proportion of cement to marble chips shall be 1:2. The thickness of top coat shall be as specified in relevant B.O.Q.

c) **Workmanship:**

Before laying cast in situ mosaic work, approval should be taken from the Owner/ Employer/ Consulting Engineers for samples of different types of marble chips (grade and shade) and which shall be kept in the office of the Owner/ Employer/ Consulting Engineers at site for reference. The sub-grade shall be chipped, thoroughly cleaned wetted and given a coat of cement grouting. Cement concrete (1: 2: 4) undercoat of stiff consistency shall be laid on the surface and proper key for the terrazzo mix shall be formed. After undercoat has fully set the surface shall be given a coat of cement grouting (coloured or grey as required) and the top coat shall immediately be laid, tamped and trowelled to an even surface. Terrazo topping including the base shall be carried out in alternate section not exceeding 3 sq.m. Glass strips penetrating through the full thickness of terrazzo and concrete base shall be used at joints to attain best quality of works. The top coat should have sufficient thickness so that after final polishing the thickness as mentioned in the Schedule of Quantities is maintained.

After striking off the finished level, the concrete top coat shall be rolled lengthwise and crosswise, so as to secure thorough compaction of marble chips and cement paste. Additional marble chips of the larger size shall be spread over the topping during rolling until 85% of finished surface shall be composed of marble chips. Immediately after rolling, the surface shall be floated and trowelled once. No attempt shall be made to remove trowel marks. After this the floor must be kept continuously moist for at least 10 days.

After the terrazzo concrete has hardened enough to prevent dislodgement of aggregate particles, it shall be ground down with an approved type of grinding machine set with free, rapid cutting carborundum stones to expose the coarse aggregate. All the materials ground off shall be removed by squeezing and flushing with water. Air holes, pits and other blemishes shall then be filled with a thin grant composed of neat cement. This grout shall be spread over the surface and worked into the pits. After all patch fillers have hardened for seven days, the floor surface shall receive a second and final grinding to remove the film of cement paste. The surface then shall be rubbed with oxalic acid powder mixed with water and when dry shall be finished by applying wax polish with felt pads.
All freshly placed concrete shall be protected from the elements and all defacement due to building operations. The contractors shall provide and use, with necessary tarpaulins to cover complete or enclose all freshly finished concrete. All angles at bases and corners are to be covered without any extra charge.

iv) Rates also to include:
Apart from other factors mentioned elsewhere in this contract, the rates shall include for the following:

a) Providing and laying 1:2:4 cement concrete for undercoat in panels including cost for providing a coat of cement grouting on sub-grade and on undercoat as specified.

b) Mixing the ingredients or terrazo mix to white cement/ approved pigments and marble chips of approved quality, maximum size and graded down as required and laying it in the top coat.

c) Curing of concrete leveling course and top coat submerging in water for 7 days.

d) Machine polishing and finish as specified above.

v) Mode of Measurement:
The measurement shall be in sqm. for the actual cast in situ mosaic flooring provided.

DADO AND SKIRTING: (In-situ)
Dado and skirting shall be laid in two layers, the under coat being laid as (1:2:4) cement concrete and the top coat with marble chips in white cement as required.

a) Under Coat: The under coat shall be in (1:2:4) cement concrete and shall be applied to the wall surface. The thickness of the undercoat shall be 16 mm over the proudest part for brick work & the concrete faces. The surface of the under coat shall be kept rough to form a key for the tap coat of the marble chips in white/ grey cement with pigment as required in different proportions. Total finished thickness shall be 25 mm (average) unless mentioned in the B.O.Q.

b) Top Coat: This shall be 9 mm thick finished to 6 mm or thickness as mentioned in B.O.Q.

c) Polishing: Same as that for flooring without machine polishing should be done.
d) Rates also to include :- Apart from other factors mentioned elsewhere in this contract, the rates shall include for the following :-

i) Applying under coat 1: 2: 4 cement concrete and roughening the surface including cost for providing a coat of cement grouting on sub-grade and an undercoat as specified.

ii) Mixing the ingredients of terrazzo mix as required and laying it in top coat.

iii) Curing.

iv) Polishing and finishing the dado and skirting.

Mode of Measurement :
Dado and skirting shall be measured in square metre for the actual area of the top coat provided.

10.5 PLAIN OR COLOURED CEMENT TILES OR TERRAZO TILE FLOORING :

i) Tiles :
Plain or coloured cement tiles and terrazzo tiles shall be manufactured as per I.S. 1237 of latest edition using grey or white cement and pigment and marble chips (white and coloured) or size as required. Tiles shall be of approved quality, colour, shade and make. The tiles shall be of approved size and the minimum thickness shall be 20 mm. A few samples of tiles to be used shall be deposited by the Contractor to the office of Owner/ Employer/ Consulting Engineers/E-I-C at site for reference.

ii) Concrete Base and Mortar Bedding :
The base of cement or lime concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the levels of the finished floor to the extent of the thickness of the tiles and mortar bedding. Lime surki mortar for bedding shall be prepared in a mortar mill.
Care shall be taken in preparing the mortar to ensure that there are not hard limps that would interfere with the even bedding of the tiles. Before spreading mortar, sub-floor or base shall be cleaned of all dirt, scum, laitance and all loose materials and then well wetted with out forming any pools of water on the surface. In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished paving surface shall be marked out. The mortar shall then evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with tiles before the setting of the mortar. The thickness of the mortar bed shall not be less than 15 mm and not
more than 25 mm. Unless otherwise specified, the proportion of mortar bedding shall be composed of 1 cement and 3 medium sand by volume.

iii) **Laying, Curing, Polishing & Cleaning**:
Tiles shall be laid as per approved pattern on the mortar bed and floated in neat cement slurry. The joints of the tiles shall not be more than 1.5 mm wide and shall be filled with neat cement slurry or required colour to match the colour of the tiles. If required, the border tiles shall be cut to proper sizes and the rate quoted shall cover for the same. No border tile shall be less than 100 mm in width, unless otherwise approved by the Owner/Employer/Consulting Engineers.

Flooring shall be kept wet for 14 days.

iv) Polishing and cleaning of the whole floor will be done as per direction of E-I-C.

**Rates to include**:
Apart from other factors mentioned elsewhere in this contract, the contractor’s quoted rate shall include for the following:

a. Cleaning for the base and providing and laying bedding mortar and leveling.
b. Providing and fixing the tiles in neat cement float on the bedding mortar.
c. Filling of joints of tiles with neat cement slurry of required colour to match the colour of the tiles.
d. Polishing, finishing and cleaning. All labour, materials and use tools and carrying out the item as specified above.

vi) **Mode of Measurement**:
The tile shall in square metre for the actual area provide measurement for the tile flooring.

**DADO AND SKIRTING**:
a) Tiles shall be as specified above for flooring except that in the case of skirting the height of tiles may be less than the height of 1 full tile.

b) **Mortar Backing**:
The proportion of mortar for backing shall be 1.3 cement mortar.
c) **Fixing dado – Skirting tiles**:
Dado or skirting shall be fixed only after fixing tiles on the floor. The tiles shall be soaked in water before being used for dado or skirting work. The tiles shall be fixed when the backing mortar is still plastic and before it gets stiff. All the tiles shall be covered with an additional layer of neat cement base and tiles shall then be pressed in mortar and gently tapped against, the wall with wooden mallet. The fixing shall be done from the bottom of wall upward without any hollows in the beds or joints. Each tile shall be fixed as close as possible to the adjoining tile. The tile shall be jointed in neat cement slurry to match the color. Joint of the tiles should not exceed 1.5 mm in width and they shall be uniform. While fixing the tiles in skirting or in dado, care shall be taken to see that the joints to the adjoining flooring tiles below matches with the joints in the skirting or the dado tiles as the case may be or shall be staggered as directed.

d) Polishing:
Polishing may be done by hand with approved type of polishing stone. A smooth and even polished surface shall be obtained to match the finished surface of the flooring.

e) Curing: The dado or skirting shall be kept wet for 14 days.

10.6 MARBLE SLAB COUNTERS:
Granite/ Marble slab shall be of best Indian Granite/ Marble of white or any other approved colour as specified in the item. They shall be hard, dense uniform and homogeneous in texture and shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut to true shape. The rear face shall be rough enough to provide a key for the mortar but when used for shelves all the faces shall be machine polished and perfectly plane. The size of the slab shall be as per requirement of the work and thickness should be uniform.

a) Dressing and Rubbing:
Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges of the full depth. The sides thus dressed shall have a full contact if a straight edge is laid along. The sides shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edge of the slabs shall be true be square and free from chipping giving a plane surface.

Thickness shall be 25 mm as specified in the item.

b) Bedding:
Bedding for the Granite or Marble slabs shall be cement mortar as specified in the schedule of work of average thickness 20 mm as given in the description of the item.

Minimum thickness at any place shall be not less than 10 mm

b) Laying:
Sub-grade shall be cleaned, wetted and mopped. Mortar of the specified mix and thickness shall then be spread on an area sufficient to receive one slab. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped gently to bring it in level with the other slabs. It shall then be lifted and laid a side. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar is then allowed to harden a bit. Over this surface, cement slurry of honey like consistency at 4.4 kg. of cement per square metre. The edge of the slabs already paved shall be buttered with grey or white cement with or without pigment to match the shade of the granite stone slabs as given in the description of item. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. Surplus cement on the surface of the slab shall be removed. The slabs fixed in the floor adjoining the walls shall enter not less than 10 mm under the plaster, skirting or dado. The junction between the wall and floor shall be finished neatly. The finished surface shall be true to levels and slopes as directed by the E-I-C.

Rates shall include:

a) All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout and laying granite stone slabs as specified above and making up the joints with pigments / white cement etc.

b) Any cutting and waste if required,

c) Curing.

d) Cleaning the floor from all stains etc.

Mode of Measurement:

The measurement shall be in square metre for the actual granite stone flooring provided.

10.7 GRANITE WORKS

The granite stonework shall, in general, be carried out as per the PWD-SOR Specifications. The specifications for dressing, laying, curing, finishing, measurements, rate etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the PWD-SOR Specifications. The wall lining / veneer work with granite stone shall be as per the PWD-SOR Specifications for Marble work Sub Head.

Granite stone tiles and slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the Architectural drawings and as directed by the Engineer-in-Charge.
Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in-Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Granite stone slabs shall be individually packed in cardboard paper. These shall be handled carefully to prevent any damage. The stone slab procured shall be free of any surface defect or any edge damage. The damaged stones shall not be allowed to be used in the work. So the Contractor shall procure additional such quantities, to cover such contingencies. However nothing extra shall be payable on this account. The stone slabs shall not be waxed or touched up with dyes / colours.

The granite stone slabs to be procured for the work shall match the samples shown to the Contractors. Before starting the work, the Contractor shall procure and submit the samples of granite stone slab (matching to the samples shown to the Contractors) for the approval of the Engineer-in-Charge. The samples shall be submitted along with the following details:

a) Three representative samples for each type of granite stone specified.

b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d) Company profile of Suppliers.

e) Procedure for fixing including samples of fixtures such as cramps, pins, dowels etc.

The decision of the Engineer-in-Charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor. No claim of any kind whatsoever shall be entertained from the Contractor on this account. The Contractor shall then procure and get the mock up prepared at site of work for approval of quality of workmanship and the granite stone as specified. The mock up shall be prepared in lift lobby, toilet etc. on one of the floors. The size of the stones shall be as per the architectural drawings. If the quality of the workmanship and the material is as per the required standards, the mock up shall be allowed as part of the work and measured for payment and shall not be dismantled. Otherwise, it shall be dismantled by the contractor as directed by
the Engineer-in-Charge and taken away from the site of the work at his own cost. Nothing extra shall be payable on this account.

The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also no claim of any kind shall be entertained from the Contractor on this account.

The stone work may be required to be carried out in patterns, design and/or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs/ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

The following tolerances shall be allowed in the dimension of granite stone slab:

**Slabs: Tolerance**

a) Length ±1 mm  
b) Width ±1 mm  
c) Thickness ±1 mm  
d) Angularity at corners ±0.25%

The stones (slab and tiles) not meeting the above tolerance limits shall be rejected and not permitted to be used in the work.

Stones slabs shall have uniform thicknesses with in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen/wash basin platforms, vanity counters, facias and other similar locations etc. shall have calibrated thickness i.e. exposed edges shall have uniform thickness throughout the length of the work.

The flooring work shall be carried out as per the architectural drawings in design and pattern (geometric, abstract etc.) and in linear and/or curvilinear portions and in combination with stones of different colour and shade and ceramic tiles etc. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost of such items.

For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m as per the architectural drawings, unless otherwise specifically permitted by the Engineer-in-Charge. Wherever required, the joints shall be provided as per the architectural drawings. Nothing extra shall be payable on this account.
For the granite stone work in treads and risers of steps at the entrance to the building from the ground to the plinth level shall be provided as per the architectural drawing, using tread stones and riser stones in the profiles of the steps shown in the architectural drawings. Based on the architectural drawings and the actual dimensions at site, the contractor shall first prepare shop drawings. However, the length of the granite stone slabs shall generally be not less than 1.2 metres unless otherwise approved by the Engineer-in-Charge specifically to match the architectural details.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Engineer-in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Engineer-in-Charge / Consultant.

While fixing the granite slabs in sills, soffits and jambs of doors, windows, ventilators etc., rebates shall be made by overlapping the stones at the required places for fixing shutters for doors, windows and ventilators etc. as shown in the architectural drawings and as per the directions of the Engineer-in-Charge / Consultant. Epoxy based adhesives shall be used for fixing the granite stones to each other, as per the manufacturer’s recommendations. Any extra mortar thickness required due to the overlap arrangement shall be deemed to have been included in the item. Nothing extra shall be payable on this account. The cut exposed edges of the granite stones shall be polished / moulded as per the architectural drawing.

The granite stone slab shall be fixed for wash basin counters as shown in drawing. The stone shall have uniform thickness and shall be provided in sizes as per the architectural drawings. The stone slab shall have uniformly leveled surface after fixing. All the joints shall be finished smoothly. The necessary cutouts for fixing wash basins shall be provided in granite.

The edge moulding / nosing/ polishing to the cut exposed edges of the granite stone slab to be used in flooring, skirting, dado, sills, jambs, soffits, risers, treads etc. shall be provided in a workmanlike manner as per the architectural drawings.

The granite work shall be adequately protected by a layer of Plaster of Paris, which shall be maintained throughout and removed just before handing over of the works for which nothing extra shall be payable.

Wherever the granite stone slab dry cladding is provided exposed to environment, both the surfaces of the granite stone slabs shall be treated to make the surfaces hydrophobic by applying one or more coats of water repellant / hydrophobic clear coating of water soluble siliconate based impregnating agent DC 777 of Dow Corning or equivalent brand. The formulation shall be prepared and applied as per the manufacturer’s recommendations. Before applying the formulation, the surface preparation shall be done as per the manufacturer’s recommendations. The stainless steel pins /
anchors / cramps shall be provided for fixing granite as shown on drawing. The surface shall be cleaned using water and the formulation shall be applied on the damp surface.

**Mode of Measurement :**

The measurement shall be in square metre for the actual granite stone flooring provided.

### 10.8 KOTA STONE FLOORING :

a) **Stone slab :-** The stone slab shall be hard, even, sound and durable. The slabs shall be machine cut in a place parallel to the natural bed of the stone. They shall be of required colour, size and shape. Stones having yellowish strips shall not be used. The thickness of slabs shall be 25 mm to 30 mm and total thickness of floor finish including bedding mortar shall not exceed 50 mm.

b) **Dressed stone flooring :-** The exposed faces shall be fine chisel dressed or rough tooled as directed. All angles and edges shall be true, straight and square.

c) **Setting :-** Each slab shall be thoroughly wetted before being laid. It shall be laid in cement mortar 1:4 (1 cement : 4 sand) or lime mortar (1:2) and jointed with grey cement slurry mixed with pigment to match the shade of the slab and gently tapped down with a wooden mallet so that no hollows are left beneath the slabs. Where pointing is not required to be done, the joints shall be leveling flush with a trowel at the time of paying.

d) **Joints :-** Shall be uniform and full of mortar. They shall be in line and shall not be more than 3 mm in width. They shall be rubbed and pointed after completion.

### 10.9 CERAMIC TILES OR SPARTEX OR REGENCY TILES IN FLOOR & WALL :

a) **Tiles :**

White glazed tiles ceramic tiles including specials shall be of approved make and quality. Samples of tiles shall be got approved by the Owner/ Employer/ Consulting Engineers/E-I-C, who will keep them in his office for verification as to whether the materials brought, conforms to the approved samples. Tiles should be soaked in water for at least 2 hours before use and stacked neatly for draining out the dripping water.

b) **Mortar backing/ Leveling course :**

All joints in the brick work shall be racked out to depth equal to not less than the width of the joints or as directed by the Owner/ Employer/Consulting Engineers/E-I-C. Concrete surface shall be properly hacked, all dirt, soot, oil, or any other material which might interfere with satisfactory bond shall be removed. The surface shall be cleaned and scrubbed with fresh water and kept wet for hours prior to applying backing mortar. The tile work shall not be commenced unless the preparatory leveling course work is passed by the E-I-C. The proportion of mortar for leveling course shall be 1.4 cement mortar. Sand in mortar bedding shall be from approved source. The thickness of mortar backing
for leveling course shall not be less than 6 mm and not more than 10 mm. The leveling
course should be properly cured for at least 7 days and dried before commencement of
tile work.

c) Fixing of tile:
The work in wall/ dado shall be done only when the fixing of tiles in floor is completed.
The glazed tiles/ ceramic tiles shall be soaked in water for at least 2 hours before being
used. 5 No. of stone chips are to be fixed at the back of the tile with Araldite glue as key.
A thin layer of cement mortar (1:4) is to be used as paste for fixing of tile as backing
mortar. No hollow should be audible when the fixed tiles are tapped.

d) Cleaning:
After the tiles have been fixed the surplus materials that may have come out of the joints
shall be cleaned off before it sets. After complete curing, the tile work shall be washed
and thoroughly cleaned.

Rates also to include :-
Apart from other factors mentioned elsewhere in this contract, the rates for the item of
dado or skirting shall include the following :
i) Backing Mortar/ Leveling course.

ii) Providing and fixing tiles including all specials like round edges, angles capping,
cutting of tiles etc.

iii) Fixing , jointing of the tiles with the adhesive/ joint filler of approved shade,
cutting necessary holes for pipe outlets.

iv) Curing.

v) Cleaning.

vi) All labour, materials, use of tools and equipment's for carrying out the items as
specified above.

10.10 VITRIFIED TILE FLOORING & DADO WORKS:
Vitrified tiles of approved manufacture with nominal size of 600 x 600 mm of required colour and shade
(pastel shades) shall be used in the work. The tiles shall conform to ISO 13006 or equivalent. However,
the dimensional tolerance of the vitrified tiles shall be ±0.10% in length, ±1.0% in thickness, 0.1% in
rectangularity, 0.1% in surface flatness.

The Contractor shall procure and submit the samples of the tiles, of required colour, shade, design &
make, for the approval of the Engineer-in-charge prior to the execution of the item. The mock up ,
protection etc. shall be as specified above for the granite stone work.
The entire material shall be procured preferably, in one lot from one manufacturer to avoid any variation in the colour, shade and design of the tiles. Any tile with variation in the colour, shade and design, not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor.

The Contractor shall obtain and submit to the Department the manufacturer’s certificate for compliance of the material as per the manufacturer’s specifications and also a copy of the manufacturer’s test report for the record. The tiles shall be transported to site well packed in boxes. These shall be handled carefully to prevent any damage. The tiles procured shall be free of any surface defect, edge damage and any other such defects. The defective / damaged tiles shall not be allowed to be used in the work.

So the contactor shall procure additional quantity of tiles to cover such contingencies. However nothing extra shall be payable on this account. The work shall be carried out as per the architectural drawings and as per the directions of the Engineer-in-Charge / Consultant. The work may be carried out in design and pattern in linear as well as curvilinear portions of the building, as per the architectural drawings. Nothing extra shall be payable on account of any wastage, incidental costs etc.

The flooring / dado should be set out such that the perimeter/ corner tiles are in excess of half a tile so that the edge panels on both the sides are of equal sizes, as far as possible. The tiles shall be cut to required size and shape but with all precautions as per the manufacturer’s specifications.

The floor tiles shall be laid to required pattern with 3 mm space between the tiles using approved spacers as recommended by the manufacturers. After allowing 3 to 4 days wet curing, the joints shall be filled with polymer modified cementitious grout with polymer modified cementitious adhesive of BAL ENDURA or equivalent approved brand and with pigments of approved colour and shade as directed by the Engineer-in-charge.

The excess grout shall be wiped off with a damp sponge after fifteen minutes of application. Adequate care shall be taken before installation as well as afterwards till handing over the building for occupation. The flooring shall be free of any scratches, stains etc. at the time of handing over. Abrasive cleaners shall not be used to clean the marks. The preparation of base surface, laying, frequency of testing shall in general be as that per PWD-SOR Specifications.

10.11 VINYLE FLOORING / SKIRTING
2 mm thick vinyle flooring / skirting of approved make and shade shall be laid in required pattern and design, laid in linear as well as curvilinear portion, all complete as per the drawing fixed using VC 3
Acrylic Glue of “Pidilite Industries Ltd.” or equivalent adhesive as per the manufacturers specifications on the existing I.P.S. floor. The work shall be carried out to the satisfaction of Engineer-In-Charge in all respect.

10.12 GLASS MOSAIC DADO WORK

The work shall be carried out as per the manufacturer’s specifications. The Contractor shall obtain and submit to the Department the manufacturer’s certificate for compliance of the material as per the manufacturer’s specifications and also a copy of the manufacturer’s test report for the record.

The Glass Mosaic tiles shall be S A Series of Italia or equivalent approved make, of approved colours and shades. The size of the glass mosaic tiles shall be generally 20mm x 20mm x 4mm, and joint width of about 1.80 mm, all as per the architectural drawings. The Contractor shall procure and submit the samples of the tiles for approval of the Engineer-in-charge before taking up the work. The work shall be carried out in patterns and designs in combination of tiles of different colours and shades, fixed in linear as well as curvilinear profile, as per the architectural drawings.

Before fixing the glass mosaic tiles on the surface, the surface shall be cleaned properly and cement mortar shall be applied as per the item description and shall be sponge finished without any scratches, in true plumb and level. Thereafter, the glass mosaic tiles shall be fixed with polymer modified cementitious adhesive (minimum 2 mm thick) with white star of BAL ENDURA adhesive or equivalent including grouting the joints with polymer modified grout of required colour and shade. The tiles in the required pattern shall be laid with random mix of tiles (in combination of tiles of different colours and shades) as per the architectural drawings and as per the directions of Engineer-in-Charge / Consultant

Mode of Measurement:
Floor as well as dado shall be measured in square metres for the actual area provided.

10.13 WOODEN FLOORING

- **Seasoning and Preservation:**
  All timber used for timber floors shall be thoroughly seasoned in accordance with IS : 1141. After seasoning, the timber shall be treated with preservative in accordance with IS : 401. Seasoning and preservative treatment shall not be paid for separately and the rate quoted for the item shall be inclusive of the same.

- **Planks/ Boards:**
  It shall be of the class of timber and thickness specified in the description of the item. Only selected boards of uniform width shall be used. Unless otherwise specified or shown in the drawings, the width of boards selected shall not be less than 100 mm nor more than 150 mm. The same width of boards shall be maintained throughout except where the width of the room is not an exact multiple of the boards. In
the latter case, the difference shall be equally adjusted between the two end boards (adjacent to walls). The length of the boards shall not exceed 3 metre anywhere. Unless otherwise described in the item, the longitudinal joints of planks shall be tongued and grooved to a minimum depth of 12 mm.

- **Fixing:**

The planks should be placed over foam and the floor shall be truly levelled and should be plane. The joints shall be truly parallel and or perpendicular to the walls, unless otherwise specified. The floor shall be planed in both directions and made perfectly even, true and smooth.

**NOTE:** No wood of any kind shall be placed within 60 cm of any fire place or flue.

- **Finishing:**

The surface of the floor shall be bees waxed or finished otherwise as directed by the Engineer-in-charge. The lower face shall be painted or treated with wood preservative as directed. The finishing shall be paid separately unless specifically included in description of the flooring item.

30. 6. Measurements: Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

- **Rate:**

The rate shall include the cost of labour and materials involved in all the operations described above, with the exceptions noted in the relevant sub paras.

10.14 **HARDONITE FOR IPS/ VACCUM DEWATERED FLOORING**

Marking into bays: The complete floor should be marked off into bays. The application of Nitoflor Hardtop Standard or approved can begin when the base concrete has stiffed to the point when water evaporates from the surface.

Broadcasting of the material: The material need to be applied in two stages:

The first application is made by using 50%-70% of the total material & evenly broadcasting onto the concrete surface. When the material becomes uniformly dark by the absorption of moisture from concrete the concrete should be floated either by wooden floats or by power float for larger areas. Immediately after floating the remaining material is sprinkled evenly over the surface & floated as done previously.

Bay Edges: While applying the material at the edges extra precaution is taken by way of sprinkling more material & finishing it smoothly with a steel trowel.
11.0 PAINTING

11.1 WHITE WASHING WITH LIME

The wash shall be prepared from fresh stone lime (Narnaul/Satna or Dehradun quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient to water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 Kgs of gum dissolved in hot water, shall be added to each Cum. of thin cream. The approximate quantity of water to be added in making cream will be 5 liters of water to 1 Kg. of lime.

Indigo (Neel) up to 3 gm. per Kg. of lime dissolved in water, shall then be added and wash stirred well. Water then shall be added at the rate of about 5 liters per Kg. of lime to produce a milky solution.

PREPARATION OF SURFACE

Before white washing is started, the surface shall be thoroughly brushed free from mortar droppings and foreign-matter. Any unevenness shall be made good by applying wall putty made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it dries up.

APPLICATION

The white wash shall be applied with moon brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from top downwards, another from bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries up.

RATE

The rate shall include cost of all materials and labour involved in all the operations described above including scaffolding, protecting doors, windows, floor etc. from splashes and dropping.

11.2 WHITE WASHING WITH WHITING

Preparation of mix: Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form thin slurry which shall then be screened through a clean coarse cloth. Two Kg. of gum and 0.4 Kg. of copper sulphate dissolved separately in hot water shall be added for every cum of the slurry which shall then be diluted with water to the consistency of milk also, so as to make a wash ready for use.

Other specifications described above shall be applied in this case also.

11.3 COLOUR WASHING

The mineral colours not affected by lime, shall be added to white wash. Indigo shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer-in-charge.
A priming coat of white wash with lime or with whiting shall be applied. Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

Other specifications described in above shall apply in this case also.

11.4 DISTEMPERING

Dry distemper of required colour and (IS: 427 - 1965) of approved brand and manufacturer shall be used. The shade shall be got approved from the Engineer-in-charge before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water as specified by the
maker. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency. Distemper shall not be mixed in larger quantity than is actually required for one days’ work.

PREPARATION OF SURFACE

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

A priming coat of whiting shall be applied over the prepared surface. No white washing coat shall be used as a priming coat for distemper.

Application

The treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour.

Other specifications described as above shall apply in this case also.

11.5 OIL EMULSION (OIL BOUND) DISTEMPERING

Material: Oil emulsion (oil bound) distemper (IS:428-1929) of approved brand and manufacturer shall be used. The primer used shall be cement primer or distemper primer. This shall be of the same manufacturer as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared. The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities, at a time for a fortnights’ work. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-charge.

Preparation of surface

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular of distemper is applied.

A priming coat of whiting shall be applied over the prepared surface. No white washing coat shall be used as a priming coat for distemper.

Application

The priming coat shall be with distemper or cement primer, as required in the description of the item and as recommended by the manufacturer.

Note:

If the wall surface plaster has not dried completely cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied within six months of the completion of wall plaster.
After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rule out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (Water or other liquid as stipulated by the manufacture) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat. The subsequent coats shall be applied in the same way.

For distemper 15 cm double bristled brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

The specifications in respect of scaffolding protective measures and rute shall be as described under.

11.6 ACRYLIC EMULSION PAINT FOR EXTERIOR FINISH

a) Where specified the exterior plaster is to be finished with ACRYLIC EMULSION PAINT of M/s ASIAN PAINTS or equivalent of approved shade and colour, as approved by the Consulting Engineers.

b) The surface is to be previously cleaned and rubbed down and all inequalities and defects properly rectified.

c) The material is to be obtained from approved sources and the work shall be carried out with proper supervision and under direct guidance and instructions of the manufacturers to achieve high grade finish.

d) The rates quoted must include necessary scaffolding including erection and removal.

11.7 CEMENT PRIMER COAT

Cement primer shall be used as lease on wall finish of cement lime or lime cement plaster or asbestos cement surface before oil distemper paints are applied on them. Only approved cement primer shall be used. Primer coat shall be preferably applied by brushing and not by spraying.

PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface then be allow to dry for atleast 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

APPLICATION

Cement primer shall be applied with a brush. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. The entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion paint is applied.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

11.8 CEMENT PAINT

Cement paint shall be (conforming to IS:5410 - 1969) of approved brand and manufacture.
PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, alga, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied.

PREPARATION OF MIX

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish.

Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturers instructions shall be followed meticulously. The lid of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydrophobic qualities.

APPLICATION

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application shall be as per manufacturer’s specifications. The completed surface shall be watered after day's work.

Water cement paint shall not be applied on surface already treated with white wash, colour wash distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

11.9 PLASTIC (ACRYLIC) EMULSION PAINT:

Plastic (acrylic) emulsion paints are not suitable for application on external surface and surface which are liable to have condensation and are to be used generally on internal surface. For plastered surface a cement priming coat is required before application of plastic emulsion paint of approved brand and manufacture and of the required shade shall be used. The paint will be applied in the usual manner with brush or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hardened the next coat can be applied. The time for drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces. Thinning will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be as per manufacturer’s instructions. The surface on finishing shall present a flat, velvety, smooth finish.

If necessary more coats will be applied till the surface present a uniform appearance.

Precautions:

i) Brushes should be quickly washed in water, immediately after use and kept, immersed in water during break periods to prevent the paint from hardening on the brush.

ii) In the preparation of walls for plastic emulsion painting, an oil base putty shall be used in filling cracks, holes etc.
iii) Splashes in floors etc shall be cleaned out without delay as they will be difficult to remove after hardening.

ii) Washing of surface treated with emulsion paints shall not be done within 3 to 4 weeks of application or the time specified by manufacturer.

11.10. PAINTING PRIMING COAT OF WOOD SURFACE

Primer for wood work shall be as specified in the description of the item. Surface to be primed shall be dry and thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate wood filler material with same shade as paint shall be used where so specified. The surface treated for knotting shall be dry before primer is applied. After the primer is applied the holes and indentation on the surface shall be stopped with glaziers putty or wood putty. Stopping shall not be done before the priming coat.

11.11. PAINTING PRIMING COAT ON IRON & STEEL SURFACES

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during raking which becomes loose by brushing, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface.

11.12. ALLUMINIUM PAINT

Aluminium paint of approved brand and manufacture shall be used. The paint comes in compact dual containers with the paste and the medium separately. The two shall be mixed together to proper consistency before use. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted before the next coat is applied. The finished surface shall present an even and uniform appearance. As aluminium paint is likely to settle in the container, care shall be taken to frequently stir the paint during use.

11.13. TEXTURED PAINT

The textured finish to external surfaces of walls as per manufacturer's specification and approved by the engineer-in-charge including scaffolding etc. complete.

11.14. PAINTING PRIMING COAT ON PLASTERED SURFACE

The surface shall ordinarily not be painted shall be applied to get correct finish until it has dried completely. Before primer is applied, holes and undulations shall be filled up with plaster of Paris and rubbed smooth.

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. Painting shall be done by crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left the laying off is finished. The full process of crossing and laying off will constitute one coat.

The surface to be painted shall have received the approval of the Engineer-in-charge after inspection, before painting is commended.

APPLICATION
The number of coats including the under coat shall be stipulated in the item.
a) Under Coat
One coat of specified paint of shade suited to the shade of the top coat shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

b) Top Coat
Tops coats of specified paint of desired shade shall be applied. Each coat shall be allowed to dry for not less than 24 hours and lightly rubbed down smooth with finest wet abrasion paper to get an even glossy surface. If, however, the surface is not satisfactory additional coats as required.

11.15 TOUCHWOOD FINISH

Touch wood polyurethane clear wood finish to be applied whenever specified in the bill of quantities as per the following direction of use :-

Touch Wood Clear Matt is to be applied on filled wood surface, (Apcolite wood filler) which has been smooth sanded along the grains with emery paper No. 320. Staining with Apcolite wood strainer is also to be done. It is to be ensured that surface coated is free from all loose dust. TOUCHWOOD clear mat is a single pack system. The contents should be well stirred and strained through a clean muslin cloth prior to use. Two coat of touch wood to be applied by brush with thinner 101. The first coat of Touch Wood Clear Mat should be allowed to dry for 6-8 hours prior to sanding and recoating. Containers should be well capped after use.

11.16. INTUMESCENT PAINT

To provide anti-corrosive protection to the steelwork.

The intumescent coating is a coating that reacts to heat by swelling to produce a carbonaceous char, which acts as an insulating layer to protect the steelwork. The dry film thickness of intumescent paint to be applied to individual steel sections will depend on the size, configuration and period of protection required. Thickness figures are available from International Protective Coatings.

Top coats, also known as sealer coats, protect intumescent paint from moisture, provide a decorative cosmetic finish, and reduce dirt and dust retention. In certain circumstances and environments the top coat can be omitted.

11.16.1. SURFACE PREPARATION AND PRIMING SYSTEMS

10.16.1.1. PRIMING SYSTEM
Intumescent paint must be applied over a priming system which provides the required anti-corrosive protection to the steelwork and which will protect the steel from corrosion if intumescent paint is damaged.

11.16.1.2. SURFACE PREPARATION – STEEL
The steelwork should be abrasive blast cleaned as per standard (ISO 8501- 1:1988 or SSPC-SP6) followed by the application of the primer. The blast profile should be in accordance with the recommendation for the particular primer

11.16.1.3. SURFACE PREPARATION – PRIMER
Before application of the intumescent paint the primer surface should be of normal appearance, dry and free from all contamination. Zinc primers must be free from zinc salts. If the zinc primer is exposed to external conditions before application of intumescent paint a tie coat is recommended to prevent the formation of salts. The primer must be a continuous film, any defects, mechanical damage etc must be repaired prior to overcoating. Excessive thickness of primer must be avoided.

Recommended over coating intervals for the primer should be observed.
11.16.1.4. SURFACE PREPARATION – GALVANISED SURFACES
Due to the variability of galvanised surfaces the preferred option for preparation is to degrease and sweep blast followed by application of a suitable primer.

11.16.2. TOP COATS
Before application of top coat the applicator must ensure that the specified dry film thickness of intumescent paint has been achieved. Whenever possible the Interchar material should be allowed to harden sufficiently so that thickness readings can be taken. Indicative thickness readings can be taken on intumescent paint which is not fully hardened by measuring the dry film thickness over a shim.

If it is later found that the dry film thickness is low, certain top coats may need to be removed before more Intumescent paint can be applied.
The surface of the intumescent paint must be clean, dry and free from contamination before overcoating. Specific overcoating intervals for intumescent paint with the individual top coats, as given on the Technical Data Sheets, must be observed.
Depending on the choice of final colour of the top coat, two or more coats may be necessary to achieve full opacity. The thickness of top coat required to give a uniform finish will also be affected by the unevenness of the surface of the intumescent paint.

11.16.3. INTUMESCENT PAINT APPLICATION

MIXING
Intumescent paints are highly structured products which can build up a temporary false structure during the time it is stored in the pails or drums. Power stirring is essential to ensure that the coating is mixed to a uniform consistency to avoid cavitation at the spray pump and to ensure a steady flow. Hand held air driven mixers are the most common and are ideal for this purpose, preferably with a helical style shaft. 1 to 2 minutes of thorough mixing reaching all parts of a 20 litre pail will normally be sufficient. Manual mixing of intumescent paint is not recommended.

AIRLESS SPRAY APPLICATION EQUIPMENT
Airless spray pumps with a ratio of at least 56:1 are preferred. However, petrol and electrically driven airless pumps have also been found to be suitable by some applicators. For air driven airless spray pumps the following modifications to the normal set up are recommended:

- Remove any wet end extension hose and place the wet end directly into the coating.
- Place the pail or drum so that condensation from the pump does not run into the coating.
- All filters should be removed from the pump, lines and gun. A coarse filter (½- 1mm) can be fitted over the wet end to prevent contamination from external sources from entering the spray machine and causing blockages.
- Use the minimum length of 9mm bore fluid line. A 2 metre 6.5mm bore whip end with a swivel connection to the spray gun makes the fluid lines much easier to handle and more manoeuvrable.

11.16.3.1. FILM THICKNESS CONTROL AND MEASUREMENT
Marking of Steelwork for Identification and Traceability The dry film thickness of intumescent paint to be applied to individual steel sections will vary depending on the section size and its intended configuration as well as the number of sides to be coated, and for beams, the type of decking being supported. To ensure efficient working the applicator should be in possession of a full list of the specified dry film thicknesses and number of sides to be coated, etc and should mark the sections accordingly.

Marking with felt tip pen is a simple method but it is easily lost under coating or overspray and would not be visible when the dry film thickness is being checked. A more reliable method is to mark the details on a thin tinplate tag which can be folded to prevent obliteration by coating and then attached to the section by wire through a bolt hole.
Any method of marking must not interfere with the application or adhesion of the coatings.

11.16.3.2. WET FILM THICKNESS
During the application of intumescent paint frequent checks should be made on the coating using a wet film comb to ensure that the specified thickness is achieved. Wet film thickness readings are a guide to the applicator to enable application technique to be monitored. They should be taken as frequently as necessary to enable a “feel” for the coating, and the number of spray gun passes required, to be established.

On second and subsequent coats, wet film readings may be inaccurate due to the gauge sinking into the previous coat.

11.16.3.3. DRY FILM THICKNESS

MEASUREMENT OF DRY FILM THICKNESS
After sufficient drying time a survey of the dry film thickness should be carried out using a suitable calibrated gauge. An electromagnetic induction instrument with a statistical function to store readings and give an average is most useful.

Where dry film readings include a primer and/or topcoat an allowance must be made for these coatings and subtracted from the total reading. The following is the recommended procedure for measuring dry film thickness and acceptance criteria.

Readings should be taken on every steel section as follows:

- I sections
  - Webs: One reading per metre length on each face
  - Outer flanges: One reading per metre length on each face
  - Inner flanges: One reading per metre length on each face

- Hollow sections: Four readings per metre length spread evenly around the section

No readings should be taken within 25mm of any edge or web/flange junction.

DRY FILM THICKNESS MEASUREMENTS OVER A SHIM
Indicative thickness readings can be taken on intumescent paint which is not fully hardened by taking the readings over a shim:
- Place a rigid shim of known thickness on the surface.
- Take readings over the shim.
- Subtract the thickness of the shim, and the primer and top coat if applied, to give the thickness of intumescent paint.

DRY FILM THICKNESS ACCEPTANCE CRITERIA
The average thickness of each section should be equal to, or greater than, the specified thickness. Where any single thickness reading is found to be less than 80% of the specified thickness, a further three readings should be taken on the same face within a 300mm radius of the low reading. If one or more of the additional readings are also less than 80% of the specified thickness, further readings should be taken to establish the extent of the area of under thickness and the whole area should be brought up to the specified thickness.

Individual thickness readings of less than 50% of the specified thickness are not acceptable. The average measured dry film thickness of any member should not exceed by more than 10%, the maximum stated thickness for the particular steel shape and orientation as given in the loading charts.
11.16.3.4 CORRECTION PROCEDURE

Where the dry film thickness is found to be unacceptable because it is less than that required by the specification, remedial action will be necessary. The applicator must first establish the extent of the low thickness. Areas of low thickness may be random but frequently a pattern can be observed e.g. low thickness tending to occur on inner flanges.

Additional intumescent paint should be applied to ensure conformance with the acceptance criteria. The surface of the existing intumescent paint must be clean, dry and free from all contamination.

11.16.3.5 DRY FILM THICKNESS OF TOP COAT

The top coat dry film thickness is difficult to measure due to the variation in thickness of the underlying coats and its own relatively low thickness. It is, however, important that the top coat is applied at the specified thickness to ensure the longevity of the system without applying excessive thickness. Judging the thickness of the top coat is also made more difficult as an uneven surface will require more coating to achieve a uniform appearance.

As a guide, the number of spray gun passes to achieve the required wet film thickness can be determined by spraying on to a smooth surface. Monitoring of material usage will also give an indication of the applied thickness.

11.16.3.6 RESPONSIBILITY

It is the applicator’s responsibility to ensure that all coatings are applied in accordance with these working procedures and that the specified dry film thickness is achieved.

11.16.4. REPAIR OF DAMAGED AREAS, ERECTION DAMAGE ETC

The repair method will depend on the extent of the damage. Repairs should be carried out at the earliest opportunity using the appropriate procedure from those given below.

11.16.4.1 DAMAGE WHICH EXPOSES BARE STEEL

Unsound, damaged coatings and corrosion products should be removed to a neat firm edge. The steel surface should be a bright metal surface without polishing the substrate. Coating edges should be feathered by abrading. The priming system should be reinstated. Overlap of primer onto surrounding intumescent paint should be avoided.

The intumescent paint within the recommended overcoating limits of the repair primer should be reinstated and intumescent paint in multiple applications by brush or knife, as appropriate should be applied. If small amounts of the coating are left on a clean surface for a few minutes, solvent flash-off will give a more “knifeable” consistency. If a topcoat has already been applied to original system, overlap of fresh intumescent paint over the topcoat should be minimized. Top coat should be applied as appropriate.

11.16.4.2 DAMAGE NOT REQUIRING PRIMER REPAIR

Depending on severity of damage, damaged area should be either lightly abraded to a feathered edge, or cut out to a suitable area of intumescent paint and edges feathered out. During cutting out, the priming system should not be damaged. Intumescent paint should be reinstated to the required dry film thickness. After the appropriate overcoating interval, an approved topcoat in accordance with original specification is to be applied.

11.16.4.3 DAMAGE TO TOPCOAT ONLY

Loose or unsound coatings are to be removed to obtain a firm edge and the edges are to be feathered. All surfaces should be clean, dry, and free from all contamination. Top coat in accordance with original specification is to be reinstated.
12. Door, Window Frames and Shutters:

12.1 Wooden Section:
The specified timber which shall be used should be sawn in the direction of the grain and the sawing shall be truly straight and square. For door/window frames scantling shall be chemically treated (two coats of creosote oil/linseed oil over planed surface). There should be no patching or plugging and the frames should be simple, neat and strong. For joinery work rebates, rounding and moldings should be made before assembling. All doors, window frames must have plaster rabbit 12mm X 12mm and rabbit for receiving shutter at least 15mm deep. Wood work shall not be painted, oiled or otherwise treated before it has been approved by the Engineer-in-charge. All portion of timber abutting against or embedded in masonry or coal-tar, use of approved wood primer shall be permitted. In case of door frames without sills, the vertical members shall be buried in floor 40mm. deep. Where sills are provided, these sills shall be sunk in the floor to 40mm. depth and shall rest on damp-proof course. Sills shall be provided, where so directed. The door frames without sills while being placed in position, shall be provided with temporary wooden bracing or dry bricks well wedged between the styles at the sill level. These shall be retained to keep the frames from warping during construction, The frames shall also be protected from damages during construction. The shutters shall be so fixed that while closing, the left hand leaf of the shutter is closed first and the right hand leaf of shutter overlaps on the left hand leaf. The overlapping shall be minimum 20mm. Solid wood panels shall be made out of one or more pieces of timber of not less than 125mm. in width. In order to avoid warping, splitting and cracking, normally pieces not exceeding 200mm in width should be used. When made from more than one piece, the pieces shall be joined with continuous tongued and grooved joints glued together and reinforced with metal dowels. The grains of the solid panel shall run along the longer dimension of the panel. The corners and edges of panels shall be finished as shown in drawings and these shall be feather tongued into styles and rails. Sash bars shall have mitred joints with styles. In measuring the width and thickness of styles and rails, a tolerance can be allowed upto 1mm. Styles and rails shall be properly and accurately mortised and tenoned. Rails which are more than 180mm. in width shall have two tenons. Styles and end rails of shutters shall be made out of one piece only. Look and intermediate rails exceeding 200mm. in width may be made out of one or more pieces of timber, but the width of each piece shall not be less than 75mm. Where more than one piece of timber are used, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200mm. Jointed pieces of timber shall belong to the same pieces. The cannons shall pass clear through styles. When assembling a leaf, styles shall be left projecting as a horn. The styles and rails shall have 12mm. grooves in paneled portion for the panel to feet in. The joinery work shall be assembled and passed by the Engineer-in-Charge and then the joints shall be pressed and secured by bamboo pins of about 6mm. diameter. The horns of styles shall be sawn off. Wood sued for making the doors must be chemically treated and machine seasoned. The veneering to cover the shutters should be either teak wood veneer or
commercial ply veneer. The glue used for manufacturing must be phenol formaldehyde and must be hot pressed. The outer framing of the shutter must suit for Mortice Lock and latches. Tolerance: The finished work with a tolerance of +/- 1mm in thickness and +/- 2mm in width of styles and rails shall be accepted.

Glass panes shall be fixed by wooden beading having mitred joints. A thin layer of putty shall be applied between glass panes and sash bars and also between glass panes and the beading. A fixing of glass panes with simple putty” and beads shall not be permitted. Putty shall be prepared by mixing one part white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to from a stiff paste.

12.2 Aluminum Sections:

All works under this section should conform to the f BIS codes of latest edition as listed below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>IS Code</th>
<th>Subject</th>
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<tbody>
<tr>
<td>1</td>
<td>IS 733</td>
<td>Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineering Purposes) -Specification</td>
</tr>
<tr>
<td>2</td>
<td>IS 737</td>
<td>Wrought Aluminium and Aluminium alloy sheet and strip for general engineering purposes -Specification</td>
</tr>
<tr>
<td>3</td>
<td>IS 1285</td>
<td>Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) - Specification</td>
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<td>4</td>
<td>IS 1868</td>
<td>Anodic coating on Aluminium and its Alloys-Specification</td>
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<td>5</td>
<td>IS 1948</td>
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<td>6</td>
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<td>7</td>
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<td>8</td>
<td>IS 3965</td>
<td>Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.</td>
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<td>9</td>
<td>IS 5523</td>
<td>Method of testing anodic coating on aluminium and its alloys.</td>
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<td>10</td>
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<td>12</td>
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Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304. The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-in-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge and nothing extra shall be paid on this account.

12.2.1 Door, Window Clamps or Holdfasts:

(a) Unless otherwise specified the clamps shall be fixed to outer side of the frame with screws. For the purpose of receiving clamps a recess of at least 12mm. deep of suitable size shall be cut into the frame. After fixing the frame true to plumb with the clamps, the exposed face of the clamps shall be covered by a thin wooden covering fixed with screws.

(b) The side of the door, window frames which remains in contact with masonry shall invariably be painted with a protective coat of paint.

12.2.2 Schedule of Fittings:

Fittings shall be of iron, aluminium or as specified. All hinge pins shall be of steel and their riveted heads shall be wall framed. Iron fittings shall be finished bright or black or copper oxidized. Brass fittings shall be finished bright (brass), oxidized or chromium-plated (electro-plated) and aluminium fittings shall be finished bright or anodized or as specified. Fittings shall be got approved by the Engineer-in-charge before fixing.

12.2.3 Performance Requirement for the finish

(i) Surface appearance: The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

(ii) Adhesion: When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is
visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-in-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

(iii) Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shall be wrapped with self adhesive non-staining PVC tape, approved by Engineer-in-Charge.

12.2.4 FIRE DOORS

Fire doors should be of 2 hour fire rating and supplied from approved makes.

HOLLOW METAL SWINGING FIRE DOOR SELECTION GUIDE


- Labeling is not obligatory but recommended.
- According to IS / BS, a fire door can be tested without having leaf of an active latch bolt but with only a self-closing device.
- A fire door MUST be self-closing. Only the active door leaf of an access panel (service ducts) or cupboards, can however be installed without a closer but with a dead lock and a “Fire Door, Keep Shut” sign placed clear on the door face.
- Unless shown to be satisfactory when tested as part of a fire door assembly, the components of any hinge on which the door is hung should be made entirely from materials having a melting point of at least 8000°C.
- If a fire door is held open, it must be equipped with a tested, automatic release mechanism actuated by an automatic fire detection and alarm system, fusible link (not if door is fitted in an opening provided as means of escape), or a door-closed delay device.
- Two fire doors may be fitted in the same opening so that the total fire resistance is the sum of their individual fire resistances. Signs and other items of hardware containing plastic should not be fitted on the non-fire side of the metal door or frame.

12.2.4 Hardware Fittings

All fittings shall be of anodized aluminium as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. Screws used for fittings shall be of the same metal and finished as the fitting. However, chromium plates brass screws shall be used for fixing aluminium fittings. Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in-charge. These shall be truly vertical or horizontal as the case may be, screws shall be driven home with screwdriver and not by hammering. Recess shall be cut to the exact size and depth for the counter sinking of hinges.
a) Butt hinges shall be of extruded aluminium alloy type.

b) Aluminium sliding door bolts: These shall be made of aluminium alloy and shall generally conform to I.S. 2681 – 1966. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of wood screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door when sliding door bolts can not be fixed, hole of suitable size shall be drilled in the door frame, cut to shape and shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

c) Tower bolts: Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head wood screws. All sharp edges and corners shall be removed and finished smooth.

d) Door Handles: The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handles shall be free from casting defects. Where the grip portion of the handle is joined with piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

e) Cast Aluminium Handles: These shall be of aluminium of special size, and of shape and pattern as approved by the Engineer-in-charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size, and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC – 15 IS : 1868 or as specified.

f) Floor door stopper: This shall be made of cast brass of overall size as specified and shall have a rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body or housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed
firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shocks. All parts of the door stopper shall be of good workmanship and finish, and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodized and anodic film shall not be less than grade AC-10 of IS: 1868 – 1968.

13.0 **GRILLS / RAILINGS**:

13.1 **M. S. GRILLS / RAILINGS**:

**MATERIALS:**

All structural steel shall conform to I.S. 226 sections for grills and shall be free from loose mill scales, rusts, pittings or any other defects affecting its strength and durability.

**FABRICATION:**

The grill shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after welding. Screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings, devices shall be of steel and shall be provided by the contractor. Manufactured M.S. grills should then be fixed in between the posts, balusters, M.S. frame work etc. to the correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost. The complete assembly of grill/railing so fixed shall be firm and there shall not be any lateral movements.

**SAMPLES:**

Samples of grill and railings shall be submitted for approval of the Engineer-in-Charge and to be got approved before taking up for mass fabrication.

**INSTALLATION:**

The approved grills shall be fixed in position where specified and shown in drawings in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing/repairing properly at the contractors cost.

**PAINTING:**

Painting shall be done as per the specifications specified under painting.

**MODE OF MEASUREMENT:**

Actual area of m.s. grill manufactured and fixed in position shall only be measured in square metre for payment. All measurements shall be taken to two places of decimal of a metre and area shall be calculated to second place of decimals of a square metre. The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, grouting etc. complete.

**FINISHING/PAINTING/POLISHING FOR RAILING:**

Teak wood hand rail shall be polished with wax polish/ french polish/solignum with two or more coats over one coat of wood primer or painted with two coats of synthetic enamel paint/flat oil paint of approved make and shade
over one coat of approved primer. M.S. grills, balusters etc. also are to be painted as per specifications specified under painting/polishing.

MODE OF MEASUREMENTS (HAND RAILS):
Hand railing shall be measured for payment in running metre. The length shall be measured along the top centre line of the hand rail and shall be measured between ends of balusters, newels, posts as the case may be up to two places of decimals of a metre. Rate shall include fabrication, leaving suitable pockets, grouting the same, providing and fixing suitable teak wood plugs, fixing, all labour, materials, transport, painting/polishing, finishing and scaffolding if necessary.

13.2 STAINLESS STEEL RAILINGS
1. The scope of the work includes preparation of the shop drawings (based on the Architectural drawings), fabrication, supply, installation and protection of the Stainless steel railing till completion and handing over of the work.
2. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.
3. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work
4. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge / Consultant. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge / Consultant. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.
5. The stainless steel shall be of grade 316 L with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.
6. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.
7. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.
8. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned and polished using non abrasive approved cleaner for the material. Nothing extra shall be payable on this account.
9. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T
& P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

10) The railing shall be fixed in position using stainless steel pipes, stainless steel posts of grade 316 L of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc. The 900 mm high railing shall be provided with three horizontal pipes and hand railing with vertical supports. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

14.0 FALSE CEILING

14.1 SCOPE OF WORK:
The work envisaged under these specifications refer to supplying and fixing in position false ceiling at any floor, any location and at any height.

14.2 MATERIAL:
The Fibre Cement Board or Gypsum Board shall be of the thickness as mentioned in the relevant items of the schedule of quantities and the size of panels and the arrangement of panels etc. for different area of the building shall be as indicated in drawings / as decided by the Engineer-in-Charge. Fibre Cement Board or Gypsum Board shall be of approved quality and shall be free from cracks, bends and other defects. Samples of materials to be used on the work shall first be furnished by the contractor and got approved by the Engineer-in-Charge. All materials which are used on the works shall strictly conform to the samples, other-wise the materials shall be summarily rejected.

The Fibre Cement Board or Gypsum Board shall be fixed to the frame work by means of suitable counter sunk brass self tapping screws not more than 200 mm. centre to centre or as directed, and all holes after fixing the screws be filled with approved filler. Necessary openings in the ceiling shall be left for trap doors, ducts etc.

14.3 ERECTION:
The Fibre Cement Board or Gypsum Board when brought to site shall be stacked carefully on floor over wooden sleeper supports. The boards shall be cut to required sizes either by sawing or by score and snap method. The edges shall be smoothened by wood rasp file or with emery paper. Wherever required the edges of each panel may require bevelling which also shall be done carefully to the correct line and dimensions.

The Fibre Cement Board or Gypsum Board shall be fixed to the frames either wooden or metallic or as mentioned in the Schedule of work. In case of metallic frame, the Fibre Cement Board or Gypsum Board are held to the frame by means of self tapping screws or by the ordinary machine screws and nuts, as directed by the Engineer-in-Charge.

Teak wood or aluminium beadings if required to be fixed shall be as mentioned in the item description and shall be carried out in best workman-like manner.
Any other treatment for finishing such as gluing of wall papers, cement or oil based paint etc. shall be as specified in the item description and shall be done as per relevant specifications.

14.4 MODE OF MEASUREMENT:
Fibre Cement Board or Gypsum Board false ceiling shall be measured in square metre as actually laid over the frame work.
The area being worked out correct to two places of decimal with length and breadth measured correct to a centimeter. The rates shall include the cost of all materials, frame work, labour, scaffolding etc. as mentioned above and in item description, unless otherwise specified.

14.5 Fibre cement board or gypsum board false ceiling and masking etc. with pressed steel frame work/anodized aluminium frame work:

14.5.1 GENERAL:
The work covered by these specifications shall consist of furnishing all labour, materials and equipment necessary for installation of the suspended false ceiling and vertical masking, with Fibre Cement Board or Gypsum Board on pressed steel frame work / Aluminium frame work interlocked and suspended by adjustable M.S. suspenders with necessary cut outs in the Fibre Cement Board or Gypsum Board for lighting fixtures, trap doors, A.C. grills etc., providing m.s. lighting troughs etc., erecting to proper line and level in the specified areas, floors and levels as indicated in the drawing and as directed by the Engineer-in-Charge.

14.5.2 MATERIALS:
All materials which are to be in-cooperated in work shall be got approved prior to bulk procurement.

14.5.2.1 Fabrication of Pressed Steel Frame:
The frame work for “snap grid” false ceiling shall be made out of tested special springs grade steel or approved cold rolled sheets of specified gauge as per schedule, accurately formed and die cuts with identical ends in automatic machine with precision tools. All workmanship shall be best quality as followed in a modern sheet metal shops equipped with all machines such as press, dies, spot welding machine, baking oven etc. and should be done in a manner that will not damage the materials. All work shall be accurately formed to the required dimensions, true to line, level and plane in all directions and properly sized to suit the exact dimension within permissible tolerances. Twisted or bent sections shall not be permitted to be used on work. Main runners and cross tees shall be of sizes as specified in the schedule/shown in the drawing. The main runners shall be slotted for cross tees and punched for hangers/suspenders. Cross tees shall have identified die formed ends accurately cut for easy, correct and proper fit assembly. Shearing, cropping shall be clean, reasonably square and free from distortion. Surfaces and joints to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign materials. The surface shall be wire brushed vigorously. Welding sequence shall be followed to avoid needless distortion and minimise shrinkage stresses.
Holes to be made in pressed M.S. sheet shall not be made by flame cutting. The flame cut or unfair holes are not acceptable with regards to connection of supported members with clearance. Where for practical reasons greater clearance is necessary, suitable designed seating should be provided. Any damages done to the walls/ceiling shall be reinstated to the original condition. The contractor shall not be entitled for any extra cost on this account.

14.5.2.2 Suspended Aluminium Grid system:
Aluminium grid system shall be of BEST LOK/EEZI LOCK or equivalent approved standard suspended aluminium grid system. The suspended ceiling grid shall be of self interlocking anodised aluminium T bars for main runners and cross runners of specified section and pattern as required to suit the span and as specified in the work schedule.

14.5.2.3 Fibre Cement Board or Gypsum Board:
Fibre Cement Board or Gypsum Board shall be plain and of specified thickness, approved best quality and shall conform in all respect to the relevant Indian Standard Specifications. The sheets shall be free from cracks, chipped edges or corners, twist dents, rough patches and other damages etc.

14.5.2.4 M.S. Works:
All MS works shall conform to relevant specification mentioned under Structural Steel here-in-before.

14.5.2.5 Fastening:
All bolts, nuts, screws, fittings & fixtures shall be of best quality and of approved manufacture.

14.5.2.6 FIXING:
The contractor shall take all necessary field measurements before the commencement of the frame work to ensure proper fittings of the work to actual condition of work at site. Particular care should be taken to examine the positions of all recessed lighting, trap doors and other openings indicated on drawings or as directed by the Engineer-in-Charge. The correct panel sizes shall be decided to suit each location. The false ceiling levels shall then be marked on walls. The position of the runners should be marked to suit the span of the area. The wall angles are to be fixed up with approved metal fasteners and then levelled correctly. The position of suspender shall then be marked on the R.C. slab as per the sizes of the panels decided for each area with due consideration to location of air-conditioning ducts, grills etc. Suspenders of type and design fabricated as per drawing and approved by the Engineer-in-Charge, shall then be securely fixed at correct points with approved metal fasteners/expansion bolts of specified dia., as per manufacturer's specifications. It shall be ensured that the hanger/suspender shall remain perpendicular and not pulled by the suspension system to any side. The runners are to be fixed to the suspenders and locked up at the joints. The levelling should start from fixed points and proceed towards the other end. The cross tees are to be fixed up at every runner joint to have stability while levelling. Neoprene rubber gasket shall then be fixed all along the frame work with approved type of adhesive. Approved Fibre Cement Board or Gypsum Board cut to correct sizes shall then be placed on the runner, starting from the centre of the width towards sides. All cross tees are to be connected and put on the approved spring
type hold down clip/pins as per drawing or as directed by Engineer-in-Charge. Holes if required to be provided in A.C. sheets shall be drilled and on no account holes shall be punched. The runner tees and tiles are to be locked with hold down clips/pins as required. Wherever grouting for frame work, suspenders etc. is required to be done in masonry walls columns/beams etc., the same shall be done after the entire frame work is properly levelled.

The contractor shall take into consideration all wastage in the Fibre Cement Board or Gypsum Board, aluminium grid system frame work/pressed steel frame work, M.S. suspenders, screws, nuts, bolts, washers etc. required for fixing Fibre Cement Board or Gypsum Board false ceiling and vertical masking while quoting his rates. Fibre Cement Board or Gypsum Board false ceiling and vertical masking shall be fixed to pressed steel frame or Aluminium grid system by means of spring clip (brass counter sunk machine screws in case of masking) of approved size, make and at approved spacing or as shown in drawing or as instructed by Engineer-in-Charge.

After fixing the Fibre Cement Board or Gypsum Board, all holes of screws etc. shall be filled with approved putty, levelled with the Fibre Cement Board or Gypsum Board and sand papered, so that no sign of screw is visible on the Fibre Cement Board or Gypsum Board.

For all the Fibre Cement Board or Gypsum Board false ceiling and vertical masking work, the Fibre Cement Board or Gypsum Board of required size and shape shall be cut as per approved panel size shown in drawing and fixed on pressed steel frame in the best workman like manner.

Trap doors/lighting recesses/troughs of approved size and shape with approved matching work, shall be provided in the false ceiling and vertical masking at the specified places.

Any damage done to the walls/columns/ceilings/plasters/floors etc. shall be made good to the original condition by the contractor at his own cost. The contractor shall not be entitled for any extra cost on this account. During the execution of this work, the contractor shall take all the precautions to prevent damage to the painted surface, plaster, floor tiles, doors etc. Contractor should specifically note that the area where the false ceiling is required to be provided will be in advance stage of completion with various finishing items such as painting, floor polishing etc. Any damage to these finishes will have to be made good by him at no extra cost to the Department.

14.5.3 SAFETY PRECAUTIONS:
No person other than workman employed by the false ceiling contractor shall be permitted access to any area over which the sheeting is being laid. The contractor should take protective measures during the progress of work. Cat ladders or roof boards, scaffolding etc. should invariably be used by men working on the roof/false ceiling/masking etc.

14.5.4 WORK TO INCLUDE:
Cost of all approved Fibre Cement Board or Gypsum Board with anodized aluminium/pressed steel frame work, adjustable M.S. suspenders, M.S. cleats, nuts, bolts, washers, screws, all labour, materials, tools, plants, approval scaffoldings, providing, M.S. cleats and fixing them with metal
fasteners/expansion bolts, nuts, washers, screws etc. to the concrete/wall surfaces and then fixing the adjustable suspenders in M.S. clamps, painting two coats of synthetic enamel paint on M.S. work as directed/as shown in drawing.

14.5.5 MODE OF MEASUREMENT:
Fibre Cement Board or Gypsum Board false ceiling with snap grid pressed steel/anodized aluminium internal grid system frame work completed and accepted as per above specifications shall be measured in square metre upto two places of decimals. The line measurements shall be taken upto two places of decimal of a metre. The width shall be measured, from wall angle to wall angle and length shall be measured as per actual. Areas of trap doors, lighting troughs, Air conditioning diffusers, Air conditioning grills and other openings shall be deducted and net areas of false ceiling so computed shall be paid for unless otherwise specified.

14.6 Fibre glass thermal insulation work at ceiling with T.W. battens frame work and covering with a.c. sheet:

14.6.1 SCOPE OF WORK:
The work envisaged under these specification covers providing and fixing fibre glass thermal insulation to ceiling at any floor, location and height as specified including T.W. battens frame work in required grid and insulation work covered with A.C. sheet/flexo board of specified thickness.

14.6.2 MATERIALS:
i) T.W. battens for frame: Battens required for frame work shall be as specified under chapter “Wood work in frames, shutters and panelling”.
ii) Thermal insulation media: The thermal insulation media shall be of fibre glass Crown 150 or equivalent approved make with K value of 0.0285 K Cal/sqm. hr. 0C, 50 mm. thick and density of 24 kg/cum. or as specified in the description of item/ in drawing. Sample of fibre glass to be used on the work shall first be furnished by the contractor and got approved from Engineer-in-Charge before mass procurement.
iii) Fibre Cement Board or Gypsum Board sheet covering: The plain Fibre Cement Board or Gypsum Board shall be as specified here-inbefore.
iv) Fire resisting paint: The fire resisting paint shall be of M/s. Garware Paints Ltd. or any other approved equivalent make and shall conform to I.S. 163. Sample of fire resisting paint to be used on work shall first be got approved from Engineer-in-Charge before bulk procurement. Ready mixed paint as received from the manufacturer without any admixture shall be used.

14.6.3 ERECTION / FIXING OF INSULATION:
i) Frame work:
The workmanship shall be of best quality. All wrought timber is to be sawn, drilled or otherwise machine worked to the correct sizes and shall be as indicated in drawing or as specified. All joinery
work shall fit truly and without wedging or filling. All necessary mortising, tenoning, grooving, matching, tonguing, housing rebate and other necessary work for correct jointing shall be carried out in the best workmanship like manner. The frame work shall be made in required grid as specified in schedule item and in drawing. The frame work shall be rigidly screwed to the ceiling with 100 mm. long G.I. wood screws and rawl plugs @ 300 mm. centre to centre (or as specified) both ways by drilling holes in ceiling through frame work. The wood work shall be painted all over with fire resisting paint of M/s. Garware Paints Ltd. or any other approved equivalent make before erection of the same in position as per manufacturers specifications and as directed by Engineer-in-Charge. If after fixing the frame work in position, any shrinking or substandard material or bad workmanship is detected, the contractor shall forthwith remove them and replace the same at his own cost.

ii) Sticking of insulation material & fixing of Fibre Cement Board or Gypsum Board: After fixing of the frame work as above, a thick coat of bitumen of approved grade shall be applied as vapour barrier in the grids of frame work and then fibre glass of required thickness shall be sticked to ceiling and panel of grids as directed by the Engineer-in-Charge. The panels of fibre glass shall be cut exact to grid size and evenly pressed. Approved Fibre Cement Board or Gypsum Board cut to correct sizes as specified in item description shall then be placed on the frame works starting from the centre of the width and work side-wards. Holes required in Fibre Cement Board or Gypsum Board shall be drilled and on no account holes shall be punched. Fibre Cement Board or Gypsum Board shall be fixed to wooden frame work with suitable size of C.P. brass screws @ 300 mm. c/c. 4 mm. wide groove or as shown in the drawing. They shall be kept to correct line, level and plane at the junctions of sheets.

Any damage done to the finishes and to walls, columns, ceilings, plasters, floors etc. shall be made good to the original condition by the contractor at his own cost. The contractor should take protective measures during the progress of work. Cat ladders or roof boards scaffolding should invariably be used by men working on the thermal insulation work.

14.6.4  MODE OF MEASUREMENT :

This work shall be measured on square metre basis. The length and width shall be measured between plastered surfaces of walls upto two places of decimal of a metre for working out the area.

14.6.5  RATES :

Rates quoted by the contractor for the work shall include cost of all materials and labour required to complete the work as per item description, as per above specifications and as shown in the drawing.
15. STRUCTURAL GLAZING SYSTEMS AND ALUMINIUM CLADDING

15.1 SCOPE OF WORKS

The scope of works under this contract includes design, supply, installation, protection, guarantees, testing and maintenance up to the defects liability period for Structural Glazing, Curtain Wall, Aluminium Cladding, Stainless Steel Sheet Cladding, Sun shading device / Sun-breaker assembly, Doors, Sky-light, Windows, Louvres etc.

The work under this section includes all Labour, materials, equipment and services as required for the complete design, engineering, testing, fabrication, assembly, delivery, anchorage, installation, protection and waterproofing of the aluminium curtain wall / structural glazing system, cladding, aluminium doors, Sky-light, aluminium windows & louvres and all in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specification provided that the same can be reasonably inferred there from. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure aluminium structural glazing system, cladding, Sky-light and louvers to the building structure. Approval of certain components of works or change / modification in components or drawings should be reviewed and approved by the consultant for recommending to Engineer-in-Charge for final approval.

The detailed scope of works consists of:-

1. The aluminium structural glazing system, cladding, Sky-light, Sun shading device / Sun-breaker assembly, aluminium doors, aluminium windows & louvres described hereafter shall include but will not necessarily be limited to the following:-
   a. Frames, vision panels, spandrels, doors and ventilators.
   b. Openable panels where indicated, inclusive of all accessories, fittings etc.
   c. Copings, soffit trimmers, and external metal cladding panels for both the wall cladding and the curtain walling system.
   d. Aluminium doors, aluminium windows, aluminium fix glazing, louvres etc. wherever indicated.
   e. All caulking, sealing and flashing including sealing at junctions with roof waterproofing and exterior wall, flashing at doorway, raised kerbs and in window surrounds.
   f. Sealant within and around the perimeter of all work under this section.
   g. Separators, neoprene / EPDM / silicon gaskets, trims etc.
   h. All steel structural framing and beam supports, anchors and attachments as required for the complete installation of the whole system, wherever specified.
   i. Inserts in concrete, anchor fasteners etc. for the anchorage of all work under this section to the approval of Architect.
j. Isolation of all dissimilar metal surfaces as well as moving surfaces similar or dissimilar.
k. Fire-stops, Flashings, Sealing of all interfaces with buildings etc.
l. Protection during storage and construction until handing over.
m. Engineering proposals, drawings and data.
n. Shop drawings, engineering data and structural calculations of all systems including framing, fasteners and cladding.
o. Scheduling and monitoring of the work.
p. All samples, mock-ups and test units.
q. Co-ordination with work of Civil Works and other agencies / contractors employed on site.
r. All final exterior and interior cleaning of the aluminium structural glazing system, cladding, doors louvres and window etc.
s. Hoisting, staging, scaffolding and temporary services.
t. Specified tests, inclusive of necessary reports.
u. Maintenance manuals.
v. Design and Performance guarantees.
w. Periodic inspection, supervision and advice by Contractor’s Senior Personnel of the System Principal as well as guarantee in approved Proforma for the quality and performance of works.
x. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the shop drawing details (including any modification made during testing) and acceptable standards of quality

15.2 REFERENCES AND STANDARDS
15.2.1 The provisions not restricted to the latest Standards listed below and mentioned in subsequent Para’s.
ANSI Z97.1.84 Safety Glazing materials used in Buildings
ASTM C 1036-90 Specification for float glass
ASTM C 1048-90 Specification for Heat treated Float Glass
ASTM E 774 –88 Specification for sealed Insulating Glass Units
ASTM C 1172- 91 Specification for Laminated Architectural Glass
ASTM C 864 – 90 Specification for compression Seal Gaskets
ASTM C 1115-89 Specification for Silicon Rubber Gaskets
ASTM C 920-87 Specification for Sealants
ASTM C 509-90 Specification for sealing material
CPSC 16 CFR 1201 Specification for Safety of glass
GTA Specification Specification for environment durability for heat
NO 89-1-6 strengthened Spandrel Glass with Applied pacifiers.
BSCP 118 Structural use of Aluminium
ASTM E 283 Air Infiltration test
ASTM E 331 Static water penetration test
ASTM E330 Positive and negative Test
AAMA 501.1 Dynamic Water Penetration Test-600Pa equivalent wind speed by propeller engine.
AAMA 501.4 At 100% of the specified lateral displacement.
AS N25 4284 Seismic test
IS 875 1987 Part 3 Code of practice for design Loads (other than Earthquake) Wind Load
In general the Contractor may follow any International Standards subject to his satisfying the Architect/ Employer that these specifications are equivalent to latest specifications issued by ASTM, ISO, AAMA, BSS & SSIR.
Copies of all standards & codes are to be followed for design, materials, Installation and testing.

15.2.2 Building Regulations
Design of the aluminium structural glazing system shall comply with all Government codes and regulations. For wind design, all calculations shall comply with the requirements of the relevant National Building Code and Indian Standard Code, unless specified otherwise.

15.3 GUARANTEE
The Contractor shall be fully responsible for and shall guarantee proper design and performance of his installed system for a period of 10 years from handing over of works. The design and installation shall conform to the best international standards. In addition specific 10 year guarantees (to be furnished in non-judicial stamp paper of value Rs.100/-) in approved Proforma shall be given for performance of glass, glazed units, anodizing, PVDF coating to cladding sheets and sealants. All the Guarantees shall be submitted before Final payment and shall not in any way limit any other rights to correction which the Employer may have under the Contract.

15.4 CONTRACTOR’S RESPONSIBILITIES
The Contractor’s responsibilities include but are not necessarily limited to the following items:

a) The Contractor shall provide and install all supplementary parts necessary to complete all items generally implied in the drawings and in the specifications though not specifically shown or mentioned. This shall include the design and sizing of all sections and anchor assemblies to meet the performance and design requirements, furnishing and installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage of the structural glazing system elements to the structure. Alternate anchorage proposals will be considered, if, in the opinion of the Consultant, the general design and intent of the drawings and specifications are maintained. The Contractor’s system therefore must perform satisfactorily as a whole.

b) Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The Contractor shall have the option of modification and addition of details provided the visual concept
and performance requirements are fulfilled. Proposed modifications shall be clearly shown on shop drawings as “Design Modifications” and acceptance of the same will not relieve the Contractor from sole responsibility for performance of the aluminium structural glazing system and cladding. The Contractor shall be solely and fully responsible for due performance of his installation based on his design and details.

c) In-plant and job site inspection: The Contractor shall allow the Consultant / E-I-C or their authorised agent full access to plants, shops and assembly points to view and inspect the processes and methods employed in the fabrication, assembly and finishing of the aluminium structural glazing system and cladding for this project. The Consultant / E-I-C will have the right to reject any and all aluminium structural curtain wall / structural glazing system and cladding components and assemblies during assembly and erection if the workmanship and intent are not in strict conformity with the approved shop drawings, design, documentation, certifications, samples and mock-up.

d) Glass, sealants and other items or materials procured by purchase shall be back to back guaranteed by the manufacturer.

15.5 SHOP DRAWINGS

15.5.1 The contractor shall prepare necessary shop drawings based on the preliminary drawings and two (2) copies of all shop drawings shall be submitted to the Consultant for review and approval. The Consultant’s review of all shop drawings will be limited to their conformity to the design concept & specifications. Consultant’s approval of the shop drawings will not relieve the contractor from any of the responsibilities and requirements as stated drawings and all other related submissions, documentation, certifications, samples and the mock-up for that work have been reviewed and approved by the Consultant. On approval of the drawings by Consultant, the Contractor shall submit six (6) copies of all drawings to E-I-C for execution at site.

15.5.2 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and full size details for all work in this section. Shop drawings shall indicate the desired dimensional profiles and modules, function, design and performance standards and, in general, delineate the scope of work. The contractor shall verify and co-ordinate these items with all applicable and/or related trades, contract drawings and specifications. Since the dimensions and modular references shown on the drawings are for specific and/or typical detail, the shop drawings shall include a full complete layout of all modular and referenced dimensions for all the aluminium structural glazing, cladding, doors, windows and louvres and their related elements. All dimensions / modules, etc., shall be field checked as required. The full size details shall show and specify all metal sections, types of finishes; areas to be sealed and sealant materials; gaskets; direction and magnitude of thermal expansion; direction and magnitude of all applicable construction including fasteners and welds; all anchorage assemblies and components; the fabrication and erection tolerances for the work and applicable related works adjoining, attached to or in
some way related to the work covered by these specifications. The location of all static and dynamic
anchor assemblies, the direction of thermal and other applicable building movements, coordination with
concrete works and the sequence of installation shall be designated on the applicable plans, elevations
and / or sections. All details shall be subject to Consultant’s approval.
15.5.3 Shop drawings shall indicate the desired profiles, dimensions, details of metal finish and in
general delineate the scope of the work. Profile adjustments in the interest of economy, fabrication,
erection, weather-ability or ability to satisfy the performance requirements may be made only with the
written approval of the Consultant, provided that the general design and intent of the drawings and
specifications are maintained.

15.6 STRUCTURAL CALCULATIONS
15.6.1 The Contractor shall guarantee that his design will ensure the structural safety and integrity of the
curtain wall, cladding and glass panels against all natural forces, superimposed loads, environment and
consequent movements. For that purpose the contractor shall employ a competent design engineer to
design his systems and components. During the design stage, the Contractor shall interact actively with
the Consultant concerning all aspects of design and shall obtain all the information from them concerning
the structure, probable deflections and other building movements etc. The Contractor shall take full
account of all possible building movements as well as the movements of his curtain wall and cladding
systems in his design. The Contractor shall submit his detailed structural calculations for the systems
and each of their components and shall guarantee that his design will ensure the structural safety and
integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads,
and environment and consequent movements. The structure and functional design must be vetted and
approved by the Consultant. The Contractor shall obtain the Consultant’s approval to his design
calculations and to the provisions made in his design for all the building movements, and shall be
responsible for the correctness of the fixing and interaction of the curtain wall with the structure so as to
ensure that all the movements envisaged between the structure and the curtain wall area are fully taken
care of. The Contractor shall be responsible for the workmanship of fabrication and installation and shall
indemnify the Employer against all claims due to defects or non-performance during the specified 10
year Guarantee period. The provisions of this clause shall not in any way limit the Employer’s rights
under other clauses of the Contract.
15.6.2 The R.C.C. in the building structure is Grade M 30. The Contractor shall design anchorages for
this grade of concrete with adequate safety factor.
15.6.3 Three (3) sets of approved design calculations which is compatible with R.C.C. and steel structure
shall have to be submitted to Consultant.

15.7.0 DOCUMENTATION AND CERTIFICATION
15.7.1 Glass and Glazing Documentation:
The applicable glass manufacturer(s) shall submit written certification for Consultant’s review and approval stating that all glass and glazing requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and/or design parameters, compatibility to adjacent materials and in conformity with all requirements as detailed and specified in the Contract Documents. Certification shall further state that the proposed glass and glazing materials are most appropriately suited for the use or uses intended and recommended for the specific use or the selection of the glass and the glazing materials include, but are not limited to, gaskets, setting blocks, sealant, the design and dimensional parameters of the glass pockets and the compatibility of materials. Test Certificate from approved laboratories for U-values and shading factor as claimed by the Manufacturer shall have to be submitted.

15.7.2 Sealants Documents:
All sealant applications must be clearly designated on the applicable shop drawing details and referenced to a master sealant schedule specifying materials, special instructions and application procedures. The applicable sealant manufacturer(s) shall submit in writing that all sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and/or design intent, compatibility to adjacent materials and in conformity with all the requirements as detailed and specified in the contract documents. The manufacturer’s certification shall specify the optimum life expectancy, in years, for the proposed sealant materials as detailed and specified on the shop drawings and/or master sealant schedule and shall further state that the proposed materials are most appropriately suited for the use or uses intended and recommended for the specific use or uses.

15.7.3 Quality Control Documentation:
In-plant and job site quality control procedures shall be documented in writing for Consultant’s review and approval to ensure the design integrity and performance of the as built product. Documentation shall include schedule, details, isometric and/or schematic explanatory sketches cross-references to the shop drawings, data sheets, etc., all as required to intelligently witness and assess methods and materials; and to ensure that both the fabrication and installation are in accordance with the contract documents. The Employer / Consultant shall, if required, be given free access to the plant to inspect fabrication procedures. No fabrication or assembly of job site materials shall commence until the first production unit is inspected and approved by Consultant / E-I-C.

a) The in-plant quality control procedures shall include but not necessarily be limited to the following items:
   Fabrication : Tolerances, Joinery, Sleeves, etc.
   Finish Match : Approved finish controls required for matching the exposed surfaces.
   Assembly : Welds, fastener, sealants, gaskets, separators, glazing etc.
   Protection : Handling, protection, shipping etc.
b) The job site quality control procedures shall include, but not necessarily be limited to the following items:

Anchorage: Lines, grades and related building tolerances
Installation: Tolerances, finish, match, joinery, sleeves, flashing, welds, fasteners, sealants, etc.
Sealing: As recommended by the applicable sealant manufacturer(s)
Protection & Cleaning: As recommended by the applicable sealant manufacturer(s)

15.8 SAMPLES AND MANUALS:

15.8.1 The following samples of actual job site materials together with detailed technical data / catalogues shall be submitted in duplicate, unless otherwise noted, and in the sizes noted, for Consultant’s review and approval. Any omission of an item, or items which require the Contractor’s compliance with these documents does not relieve him from such responsibility.

(a) Aluminium sheet panel: Each type and thickness; 600 x 600 mm of the specified thickness.
(b) Aluminium extrusions; one only of each section; 300 mm long of specified thickness.
(c) Glass; Each type and kind, 300 x 250 mm of specified thickness and including frame.
(d) Glazing gaskets, tapes, separators, glass setting blocks, etc. each section or unit, 300 mm long or unit.
(e) Fasteners and connections devices: Each type and size.
(f) Window and door accessories, as applicable.
(g) Flashings and finish samples.
(h) Cladding.
(i) Samples submitted should also include assembly of various components forming a typical fixing and details complete with flat sheets, glazing, extrusion, fastener, sealants etc.

15.8.2 Mock-up

Before the fabrication and site installation is taken up, the Contractor shall put up a mockup of his proposed curtain wall / structural glazing system & aluminium cladding system at least 4.00 m high and 3 modules wide incorporating all types of in-fill panels, fire-stop, flashing, shadowbox, bracket, hardware and fixtures. A mock-up of 4 panels of cladding shall also be put up. The mock-up are essential for final approval of all materials and installation details by the Consultant.
The Contractor shall submit samples and catalogues of door / window elements for approval, as applicable.

15.8.3 Maintenance Manual:

Submit Maintenance Manuals approved by Consultant in three (3) copies each indicating the detailed procedures for the periodical inspection maintenance and cleaning of all the structural glazing, cladding, doors, windows and louver elements, finishes etc.
15.9 INSPECTION OF COMPONENTS:
15.9.1 The Contractor shall submit fortnightly report on the results of the inspection of the components, in a format approved by the Consultant.
15.9.2 The Contractor shall submit a description of the procedure of delivery, hoisting, storage, handling, fixing, scaffolding, temporary working stage or gondola, protection and cleaning.

15.10 STORAGE, PROTECTION AND PROGRAMME
15.10.1 The Contractor shall submit a schedule on the procedure for inspection during installation so as to maintain quality control on the job site.
15.10.2 The Contractor shall submit a detailed method statement for the protection of the surface of the aluminium structural glazing & cladding members during delivery and erection, with description as to when the protection can be removed.
15.10.3 The Contractor shall submit weekly reports on the inspection of erection and installation as direction by the PMC.
15.10.4 Delivery and Storage of Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials will not be exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.
   a) Aluminium wall cladding / Factory made structural glazing units and / or their components shall be transported, handled and stored in a manner to prevent damage of any nature.
   b) Accessory materials, required for erection at the site shall be delivered to the site in labeled containers by the manufacturer.
   c) All units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation should be replaced.

15.11 PERFORMANCE REQUIREMENTS
All components, assemblies and completed work included in or permit to the work of this section shall conform to or exceed the following performance standards and comply with all applicable and governing building codes and regulations.
15.11.1 Thermal Movement: Provide for noiseless contraction and expansion of component materials for an ambient temperature range of +10°C to 70°C and a material temperature range of 100°C without buckling, opening joints, glass breakage, undue stress on fasteners, or other detrimental effects. There should be allowance for vertical and horizontal expansion. For fabrication, assembly and erection, procedures shall take into account the ambient temperature range at the time of respective operations.
15.11.2 Building Movement and Related Building tolerance. The design and installation of the structural glazing system shall accommodate all inherent building movements and/ or deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or
any detrimental effect to, the performance requirements herein specified. The Contractor shall verify and co-ordinate all such movements and/or tolerances with the Consultant so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain wall and aluminium cladding and vice versa.

15.11.3 Thermal property:
All insulation materials, fire-stops and smoke seals shall comply with the current requirements of WBF&ES (West Bengal Fire and Emergency Services).

15.11.4 Structural Properties:
a) The design of curtain wall/structural glazing system and aluminium cladding and all related components shall comply with the requirements of National Building Code I.S.875 and Indian Standard Code I.S.456.
b) No curtain wall/structural glazing system and aluminium cladding elements including sealants and sealed joints shall sustain permanent deformation or failure under loading equivalent to 1.5 times the specified design wind pressure.
c) Deflections: The specified deflections must be reduced if they are in any way detrimental to the aluminium structural glazing and cladding elements and sealants.

15.11.5 General
1) All braces, supports and connections for the aluminium curtain wall/structural glazing and cladding shall be designed, provided and installed complete as required.
2) Anchors for curtain wall shall be located within a maximum distance of 500 mm above or below the R.C.C. floor slab unless specifically approved otherwise by the Consultant.
3) Variations from schematic layouts indicated on the drawings may be permitted but only if a proposed revision does not, in the Consultant’s opinion, deviate from the design intent, cause excessive stress in the structure, cause excessive deflection, inhibit thermal and building movement or conflict with other requirements.
4) Member shapes and/or profiles if schematically shown on the Consultant’s drawings are not necessarily the exact shapes required or best suited for the particular condition. Final shapes and locations shall be as designed by the contractor and are subject to the Consultant’s review and approval.
5) The height-from the finished floor level to the top of the window sill shall not be less than as shown in the drawing. The horizontal or lateral load on such transom/railing (where not backed by an R.C.C. parapet) shall be designed in accordance with the following criteria i.e. a horizontal UDL at 0.74 KN/m run, UDL supplied to the infill of 1.0 KN/m² and a point load applied to part of the infill at 0.5 KN.
6) No holes shall be burned, filed or drilled in any structural steel members unless approved by the Consultant in writing.
7) The contractor shall provide detailed layouts, alignment jigs etc. for the proper and exact placement of all welded anchor studs, anchorage components, embedded anchor assemblies etc.
8) All metal structural glazing and cladding elements and their applicable anchorage assemblies shall be designed to accommodate all thermal and building movements without any harmful effect to the structural glazing and cladding.

9) No field forming, cutting and/or alterations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No unfinished surfaces will be permitted on exposed surfaces.

15.11.6 Concrete Tolerances:
a) The contractor shall take into account tolerance in concrete and masonry surfaces to which the structural and glazing framework is fixed.
b) In general, the construction tolerances in the building shall be as follows.
   - Surface level of floor slab, sills and lintels -10 mm
   - Plumb in a storey height -10 mm
   - Plumb in full height of building -14 mm
   - Cross – diagonal distortion between columns -14 mm
   - Max. displacement of any point on External Facia from its true location -14 mm

15.11.7 Lightning protection
The whole of the curtain wall when having insufficient clearance from the lightning protection system shall be bonded as directly as possible to the lightning protection system. At each end of each continuous length of curtain wall, cladding or louvers, provision shall be made at top and bottom for bonding for electrical works. The exact locations and details of the bonding points shall be as determined by the Consultant.

15.11.8 Fire-stop and Interface with building.
Joints in the curtain wall / structural glazing system between successive floors shall have the required fire resistance of at least 2 hours and shall comply with requirements of WBF&ES. A fire-stop-cum-smoke seal shall be provided at each window-head level. In addition the Contractor shall provide aluminium flashing to approved design at the window sill level and on 2 sides of vision panels. All interfaces with building structure, and other elements shall be sealed / flashed / provided with expandable gaskets to Consultant’s approval.

15.11.9 Sound Control
Provisions shall be made (e.g. capping of all ends of mullions) to prevent sound transmission through the system. Provisions shall also be made to prevent metal to metal rubbing noise due to thermal changes and wind pressure. Desired sound levels should be 35 - 45 dB and shall not be more than 45 dB.
MATERIALS

15.12 GENERAL:
15.12.1. Materials and components used shall be of the best quality and suitable for the purpose to Consultant’s approval and shall have been tried and tested in similar environments.
15.12.2. Aluminium panels shall be of a minimum thickness of 2 mm and of max. 3 mm for solid sheets, and 4 mm for insulated composite units.
15.12.3. All materials shall be free from any defect that may impair the strength, functioning or appearance of the glazing and cladding system or adjacent construction.
15.12.4. Testing by independent testing laboratories or review of data by the Consultant shall not relieve the Contractor’s responsibility to verify for himself that the work conforms to the intent of the contract documents.

15.13 METALS
15.13.1. In general, metals shall comply with relevant Indian and International Standards.

15.13.2. Aluminium Wall Cladding
The aluminium cladding shall be fabricated with a minimum of 4 mm thick aluminium composite panel of approved make comprising of a thermoplastic resin core sandwiched between two skins of aluminium alloy. The panels shall be PVDF coated to minimum 35 micron thickness in approved metallic colour. The resin content of the PVDF shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick or otherwise protected as per Consultant’s approval. The insulation in-fill of the composite panel shall be non-toxic on burning.

15.13.3. Fasteners: The type, size, alloy, quantity and spacing of all fasteners and / or anchorage devices shall be as required for the specified performance standards.

a) Bolts, anchors and other fastening devices shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise noted, shall be suitable for the conditions encountered, and shall be torque tightened, where required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners.

b) Fastening devices between aluminium and aluminium shall be Grade 304 of AISI nonmagnetic stainless steel unless otherwise approved.

c) Fastening devices between aluminium and dissimilar materials shall be Grade 304 of AISI non-magnetic stainless steel unless otherwise approved.

d) Exposed fasteners are subject to Consultant’s approval and shall be M.S. epoxy coated.

e) Self-locking fasteners shall be stainless steel of grade 304 with nylon inserts or patches.
15.13.4. Extrusions:
All aluminium extrusions shall conform to the system principal’s specification for tolerances which shall, in any case, be better than DIN standards. Any section not to the tolerances shall be rejected. In general aluminium alloy for extrusions shall be 6063 T5 or T6 as per B.S.1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application and shall be approved by the system principal. All aluminium sections shall be either anodised in approved colour to a minimum thickness of 35 microns or coated with PVDF except for sections concealed from view behind cladding which may be mill-finished. All surfaces abutting the parent sections and designed to receive sealants shall have adequate sealant contact and adhesion. They shall be finished to match parent sections.

15.13.5. Aluminium Flashing
Flashings concealed from view shall be made from mill-finished aluminium sheets 1.5 mm thick. Visible flashings (e.g. on periphery of vision panels) shall be 2 mm thick aluminium sheets anodised in approved colour.

15.13.6. Capping
Top capping shall be from 3 mm stretch-levelled aluminium sheets coated with 35 micron PVDF in approved colour.

15.13.7. Soffits and Suspended Ceiling System
Soffits and suspended ceiling system if required shall be of similar metal of the aluminium wall cladding with a similar finish. Colour and shape shall be approved by the Consultant.

15.13.8. Fire stops – cum – smoke seals shall be provided at successive floor levels, and shall be two hour fire resistant. Metals sections shall be in galvanised steel sections minimum 1.5 mm thick. All details shall be approved by the Architect.

15.13.9. Protection:
Materials used as permanent or temporary protection for metals shall conform with relevant Indian / International Standards.

15.13.10 Brackets:
Brackets shall be of chromotised Aluminum of grade 6161-T6 or 6005-T6 conforming to ASTM 6511/A and approved by Consultant. Slots in brackets shall be pre-drilled / punched and not flame-cut.

15.13.11 Hardware and Fittings:
All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs etc. for doors windows and openable panels shall be stainless steel to best International standards and approved by Consultant. Hinges for openable panel shall be stainless steel friction hinges / stays selected for specified wind load and dead loads or specifically extruded in-built hinges.
14.0 SEALANTS & GASKETS
15.14.1 All sealant applications must be clearly designated on the applicable shop drawings details and reference to a master sealant schedule specifying materials, special instructions and application procedures.
15.14.2 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required cure and optimum performance. Sealants must not degrade and / or fail under all design conditions including, but not limited to thermal movement, water, ultraviolet exposure and / or other adverse environmental conditions. The designation of sealant types noted on the drawings is intended for general design guidance. Final selection by the contractor for the sealant types shall be based on their conformity with the Performance Requirements herein specified and subject to Consultant’s approval. Maximum precautions shall be taken to prevent failure of sealant.
15.14.3 Structural sealant:
Structural sealant shall be Dow Corning Silicone sealant 995, GE ultraglaze 4000, or equivalent recommended by manufacturer. All exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly), perimeter, metal to concrete joints shall be silicone base sealant, preferably 2 component, in approved colour, conforming to the manufacturer’s recommendations for the specific uses and performance criteria. The manufacturer shall conduct laboratory test for adhesion for each lot of aluminium sections and glass. Laboratory reports shall be submitted to the Engineer-in-Charge.
15.14.4 Weather Sealant:
The grades of sealants for concealed metal to metal and metal to concrete joints such as embedment and lapping of flashings elements to be installed or embedded in a full bed sealant shall be the best recommended by the manufacturer for the application. (Dow Corning, GE or equivalent).
15.14.5 Joint fillers and back-up materials shall be non-gaseous polyethylene foam, sponge neoprene as per written recommendations from the applicable sealant manufactures for each specific application. Shape, size, hardness, compatibility and bond breaking requirements are all factors to be considered.
15.14.6 All sealant must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and / or applied colour coatings.
15.14.7 Exposed assembly sealant will not be permitted at any wall area.
15.14.8 All sealants shall be given 10 years Guarantee for materials, workmanship and performance from the date of completion of Contract.
15.14.9 Caulking compound: Dow Corning 991 or approved equivalent, one part gun grade consistency, colour to match adjacent material or approved by Consultant for use around frame or between frame and floor slab.
15.14.10 GASKETS:
A) SILICON GASKET: All Gaskets and seals shall be SILICON of approved quality, compatible with substrates, finishes and other components they are in contact with.
15.15 SEPARATORS
Separators between steel and aluminium members and wherever required shall be rigid type, high impact, smooth both side Teflon with a minimum thickness of 0.8 mm or other non-conducting materials as approved by the Consultant.

15.16 GLASS
15.16.1 All glass and glazing materials shall be verified and co-ordinated with the applicable performance requirements.
15.16.2 Glass and glazing work shall be finished and installed as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and should be made ready for glazing. Any pane which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor’s expense. All glass shall be of accurate sizes with clear undamaged edges and surfaces which are not disfigured.
15.16.3 Glass shall conform to the quality, thickness and dimensional requirements specified in US Federal specification DD- G 0451 C.
15.16.4 Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260 mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripples shall be consistent and extent shall be acceptable to Consultant. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional. Surface compression stress of heat strengthened glass shall be within 320 – 450 Kg/cm2
15.16.5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Consultant. All glass shall be delivered to site with the manufacturer’s label of identification attached.
15.16.6 A complete list of materials to be used should be submitted for approval by Consultant including the sealants proposed and such samples as may be required. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility.
15.16.7 Sealants in factory-glazed panels shall be fully cured prior to shipment to projects site and installation.
15.16.8 All glass breakage caused by the Contractor or his sub-contractor because of the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.
15.16.9 The Contractor shall be responsible to deliver to the Employer without any charge, replacement for any unit of glass and glazing that fails within the Guarantee period of Ten (10) years from date of completion of Contract.
15.16.10 The glass glazed panels / structural glazing frames for the structural glazing system shall be capable to withstand lateral imposed loads and comply with requirements of local building codes.

15.16.11 Glass thickness should be selected in accordance with AS 1228 – 1989 “Glass in Buildings Selection and Installation” to satisfy design performance requirements and local design codes.

15.16.12 Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spalls, discolouration, visibly imperfect coating, chipping, and bubbles or delamination of opacifier film shall be limited in accordance with the Manufacturer’s / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour.

15.16.13 Manufacturer’s glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc. shall be followed.

15.16.14 All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation.

15.16.15 Precautions specified by glass manufacturers to minimise thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowance shall be made for thermal movements due to an air temperature range of 60°C (+10°C-70°C) and a material temperature range of 100° C.

15.16.16 Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects.

15.16.17 Each type of glass shall be obtained from only one manufacturer and one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period.

15.16.18 Setting blocks for glass shall be extruded neoprene with minimum 80 durometer hardness.

15.17 GLAZING COMPOUNDS;

15.17.1 All neoprene materials shall be extruded high quality ozone resistant, cured, elastomeric, virgin neoprene compounds with durometer hardness, profiles and design parameters, lengths and locations all as required and recommended in writing by the applicable glass manufacturer (s). All neoprene glazing materials shall have smooth neat exposed surfaces, all flashings and burrs removed and in profiles, including integral locking projections to engage into the parent drawings. Furnish certified test reports to establish conformity with the specified standards.

15.17.2 Setting blocks used to support the dead load of the glass shall be extruded in silicone material conforming to the design criteria, all as recommended by the glass manufacture.

15.17.3 Jamb shims used to centre and station the glass shall be extruded in silicone material conforming to the design

15.17.4 Fixed compression and roll-in glazing gaskets shall be extruded in silicone material as recommended by the glass manufacturer. Gaskets for any one light shall be one piece with injection moulded corners free of all flashings and burrs.
15.18 METAL COATINGS:

15.18.1 All Aluminium extrusions shall be PVDF (Powder Coating) coated to minimum 35 microns of shade approved by the Architect.

15.18.2 Coatings to aluminium sections and cladding where specified shall be fluoropolymer formulated and will consist of a 3 coat system comprising primer, colour coat and clear anti abrasion top coat. The coating system shall meet or exceed all the requirements of AAMA 605 - Voluntary specification for high performance organic coatings on Architectural extrusions and panels. The total dry film thickness shall be 35 microns.

15.18.3 After selection of colour by the Architect, the Contractor shall prepare two (2) sets of two (2) samples of each which shall define the colour and gloss range and submit them for approval.

15.18.4 All samples shall be identified and have a full laboratory report attached.

15.18.5 The coating system, including materials and application shall conform to the requirements and recommendations of the paint manufacturer.

15.18.6 Testing and Sampling Procedures

In-process testing shall be performed on test specimens of equal metal thickness pretreated and finished along with the production metal and in addition to running in-process tests to assure high quality production, additional finished extrusions or panels are to be submitted to the coating manufacturer’s laboratory for extended exposure testing.

All test samples shall be properly identified with date, batch number and shift indicated. The following tests shall be conducted at least once per production shift and submitted to the Employer when required.

(i) Dry Film Thickness – evaluated with a Permascope, Isoscope or Dermatron instruction.
(ii) Film Hardness.
(iii) Dry Cross batch Adhesion
(iv) Boiling Water Adhesion Test.
(v) Gloss Measurement
(vi) Colour Examination Against Standard
(vii) General Appearance – Smoothness, free of blisters, sags, pinholes and other surface imperfections.

Testing reports shall be certified by the testing agency, manufacturer and the Contractor.

Performance Requirements:

Salt Spray resistance – withstand a minimum of 3000 hours exposure to 5% salt solution at 95%.R.H., 37.5 degrees C with no more than 1.25 mm creepage or loss of adhesion from scribed line or cut edges.

Humidity Resistance – Withstand a minimum of 3000 hours exposure to 100% R.H. 37.5 degrees C with no more than a few blisters, size No. 8 (ASTM D 714 – 56).

Abrasion Resistance – Withstand abrasion of sand with an abrasion coefficient value of 65 minimum when evaluated as per ASTM D 968-51 test method.
Mortar Resistance – Withstand wet mortar, 24 hour part test at 100% RH without gaining adhesion or any visual effect on the painted surface of solid colours.

Detergent Resistance – Withstand immersion in 3% synthetic detergent solution for 72 hours at 37.5 degrees C with no loss of adhesion no blistering and no visible change.

Colour Retention – Withstand maximum chalk rating of No. 8 for colours and No. 6 for white per test method ASTM D659-44 (1970).

Field Touch-up and Repair – The contractor and coating manufacturer shall supply materials for air dry touch up for spray or brush application as per instruction of manufacturer. Touch up shall be held to an absolute minimum subject to Consultant’s approval. The contractor shall furnish to the owner a written guarantee warranting all work in connection with organic coating system to be free from defects in materials and workmanship for a period of Ten (10) years from date of completion and to correct promptly any defect free of cost. The following are considered as defects without being limited thereto:

i) Peeling

ii) Cracking

iii) Checking

iv) Blistering

v) Chalking in excess #8 Chalk rating when measured in accordance with ASTM D659-44 (1965).

vi) Fading or colour change in excess of 5 NBS unit when calculated from measurement on a spectrophotometer or colour meter capable of colour measurement by reflectance reading in accordance with ASTM D244-68.

15.19 ALLUMINIUM STRUCTURAL GLAZING AND CLADDING SYSTEMS

15.19.1 The method of assembly, reinforcing and anchorage of the aluminium structural glazing / cladding system, where indicated, is schematic. Locations and method of providing same shall be the Contractor’s responsibility, who shall design the assembly, reinforcing and anchorage to suit each specified conditions in an acceptable manner complying with the requirements specified herein after.

15.19.2 Visible joints shall be as shown in the Architect’s drawings.

15.19.3 All parts shall be secured by concealed means wherever possible and where exposed to view, screw positions are to be indicated on the preliminary drawings. Exposed screws shall be of the countersunk type coloured in same finish as of aluminium or non magnetic stainless steel and shall be evenly and neatly located in an approved manner.

15.19.4 All components shall be assembled, secured anchored, reinforced, sealed and made Weather-tight in a manner not restricting thermal or wind movements of the structural glazing. Sealants shall be concealed wherever possible.

15.19.5 All fastening into or through aluminium shall be SS-306 as approved by Architect.

15.19.6 Free and noiseless movement of all the components of the Curtain Walling system due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, shall be achieved
without strain to the glass, without buckling of any components and without excessive stress to any members or assemblies.

15.19.7 Aluminium surfaces in contact with mortar, concrete, plaster, masonry, wet application of fire-proofing and absorptive materials shall be coated with an anti-galvanic, moisture barrier material.

15.19.8 Waterproofing:
a) A complete drainage system must be incorporated into the structural glazing frame work. Water leakage and condensation shall be drained or discharged to exterior face of the wall and all internal spaces vented by acceptable means to ensure air pressure equalization wherever possible.
b) Drainage system will be sealed off at every floor to prevent infiltrated water from leaking to lower floors.
c) Movement of water behind and on exposed surfaces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to avoid the potential for algae and fungus growth as a result of standing or trapped water.
d) The junction of bracket connecting S.S.Screen with reflector system & structural Glazing system shall be fully protected against ingress of water by providing suitable water proofing systems as approved by Consultant.

15.19.9 Anchorage System and Building Frame
Each glazed unit shall be fixed to the structural slab at each floor level. All fasteners shall be SS-304 of AISI. The contractor shall also make necessary modifications to the anchor fasteners to suit existing site conditions of steel reinforcement without additional charge.

15.19.10 Mullions and Transoms
a) The sections of mullions and transoms shall be designed to restrict deflection under wind pressure as specified and shall be rigid enough to support and retain the glass spandrel under all conditions. The mullions shall be designed if required, to act as guide tracks for gondolas to permit its free movement in vertical direction for window washing and to sustain concentrated loading by the gondola cage. The mullions & transoms should cater for the loading of S.S Screen with reflector.
b) Reinforcing members, where used, shall be completely enclosed and if fabricated from steel shall be galvanised and protected with primer and two coats of zinc chromate.

15.19.11 Window units (Vision Panels)
All windows shall be glazed from inside where possible. All cladding as well as internal glazing beads, if any (unless otherwise specified) shall be in anodised aluminium.

15.19.12 Spandrel Units
a) Spandrel shall be of glass having equal colour matching with vision areas with opacifier coating.
b) Structural spandrel beam, structural glazing fasteners and other construction shall not be seen through the glass from the exterior and shall be fully concealed behind shadow box.
c) A shadow box shall be provided a distance behind the spandrel glass panel. It shall consist of 50 mm semi-rigid fibre glass insulation of minimum density of 48 Kg/cum., and 0.8 mm galvanised sheet steel tray natural finished. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done.
d) Two hour rating fire stops–cum–smoke seals shall be constructed continuously at the spandrel to the approval of the Chief Fire Officer and other authorities.

15.19.13 Ventilators, Openable Windows and Doors
a) Ventilators, windows and doors shall be provided at positions as shown on the drawings. The ventilators when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified.
b) All hardware and accessories shall be supplied by the contractor and when exposed shall be of stainless steel or approved aluminium alloys in approved finish.
c) Minimum aggregate openable area of the ventilator shall be as given in the Architect’s drawings.
d) The detailed system of the ventilators and doors must be proposed by the tenderer keeping the position as shown on the drawings.

15.19.14 Coping and Soffit Trimmer
a) All coping and soffit panels shall have suitably designed frame reinforcement and be fixed rigidly to the structure.
b) All joints between coping / soffit panels and between coping / soffit panels to structural glazing frame and other sections of the work shall be tightly sealed up. Effective drainage system shall be provided to drain out the water that may penetrate through the joints.

15.19.15 CLADDING (Aluminium Composite panels)
Cladding shall be non-toxic composite aluminium panels of adequate strength with approved aluminium details. The panels shall be 4 mm thick composite units finished with PVDF coating minimum 35 micron thick of approved metallic colour. The resin content of the PVDF coating shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick, compatible with adhesives for stiffeners if any or given a polymer coating. The insulation fill of the composite panel shall be non-toxic on burning. The fabrication and installation of the cladding systems shall be carried out as per manufacturer’s instructions with invisible / concealed fastenings, aluminium sub-structure, silicon sealants properly toolled etc. All cladding panels of one kind shall be obtained in one lot from the manufacturers. Each panel shall be guaranteed for a minimum flatness of ±1 mm from the true face after installation under no-wind conditions.
Deviations from the true alignment of adjoining panels shall not be cumulative. Full load deflections shall be kept to the minimum possible. Each panel shall be capable of withstanding wind pressure without any permanent deformation. The cladding system shall be adequately ventilated. The air gap between the cladding panels and the concrete / block wall shall be at least 50 mm to allow proper ventilation of the rainscreen system. The cavity shall be closed by a perforated bird / vermin-proof closer at bottom and by a flashing at top. The fabrication processes including cutting, grooving, benching, folding, joining, rout-in as well as installation shall be performed as per manufacturer’s instructions. The panels shall be backed by approved aluminium supporting framework, fixed to walls with aluminium brackets.

LOUVERED PANELS
15.20.1 Louvered panels shall be provided at positions as shown on the drawings (preferably at ducts and ventilation shafts).
15.20.2 Louvres shall be of 35 micron PVDF coated of approved shade aluminium fins of Aerofoil shaped blades of Min 1.5 mm thickness with an assumed efficiency of 50% unless otherwise specified and shall be complete with stainless steel bird-proof wire mesh (18 gauge) fixed internally.
15.20.3 All hardware and accessories shall be, when exposed, of non-magnetic stainless steel and / or coloured aluminium to match that of structural glazing / cladding wherever possible.

15.21 FABRICATION
15.21.1 General: All assemblies shall be fabricated and assembled in accordance with the drawings and the requirements of these specifications. Deviations of any nature, without approval of the Consultant shall not be permitted.
15.21.2 Tolerances: A schedule of fabrication tolerances for all major wall cladding components shall be furnished. In addition to the fabrication tolerances, there should be provision for thermal movement including assembly and installation tolerances for all major and/or applicable wall cladding components and/or assemblies.
15.21.3 Workmanship
1) All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and in full conformity with the applicable provisions of the listed References and Standards and/or otherwise noted on the drawings or as specified herein.
2) All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and design criteria.
3) All forming and welding operations shall be done prior to finishing, unless otherwise noted.
4) All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, waves or flaws of any nature impairing strength or appearances; fitted with proper joints and intersections and with specified finishes.
5) All work shall be erected true to plumb, level, square to line, securely anchored, in proper alignment and relationship to work of other trades and free from waves, sags or other defects.

15.21.4 Joints in Metal Work
1) All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise shown or required for thermal movement, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight.
2) Where two or more sections or metals are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any point materials. Extrusions shall be finished to eliminate any edge projection or misalignment at joints.
3) Physical samples of all joinery elements should be furnished for comparative appraisal and approval of the production materials. Physical samples of all typical wall intersection assemblies shall be colour coded on surfaces and/or areas to receive sealants.

15.21.5 Shop Assembly
As far as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked with the approval of Consultant, before disassembling to ensure proper assembly later in the building.

15.21.6 Sleeves
Unless otherwise noted, all aluminum sleeves shall be extruded sections designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve.

15.21.7 Fasteners
1) All fasteners shall be of SS-304 of AISI stainless steel with self locking devices, unless otherwise specified, and of sufficient size and strength to withstand the applicable design materials. The spacing and quantities of fasteners shall be as required to develop the maximum strength of the member they secure or support. Washers and/or other accessory items shall be of the same material as the fastener.
2) All fasteners shall be concealed unless otherwise shown or approved. The head style for all exposed fasteners shall be countersunk oval head unless otherwise specified on the drawings. Exposed fasteners shall be finished to match surrounding metal finish.
3) All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all fasteners conform to the designated and approved type, size, material, spacing, etc. When certain items are not readily apparent, such as material and alloy or torque tightening requirements, special instructions for the identification and appraisal of such items shall be issued.

15.21.8 Protection of Metals
1) Protection against galvanic action shall be provided wherever dissimilar metals are in contact.
2) Aluminium which is to be in contact with cured concrete, mortar or plaster shall have the contact surfaces protected wherever crevices between the contact surfaces may entrap moisture and corrosive elements. All metals, except stainless steel, which are to be in contact with fresh concrete, mortar or plaster, shall have the contact surfaces protected with epoxy paint.

3) A schedule of all protective coatings and related items including the designation of area and/or specific locations, materials used, special instruction, specification data sheets, etc. should be furnished to Engineer-in-Charge.

15.21.9 Welding

1) All welding in aluminum work shall be done by the inert gas shielded arc or fluxless resistant techniques and with electrodes and/or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings.

2) Welds in galvanized metal shall be touched up with zinc rich paint.

3) Welds behind finished aluminum surfaces shall be so done as to eliminate distortion and/or discolouration on the finished side. When required, weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and / or grinding. Low heat filled welds are to be provided using chill bar on finished side to eliminate dimpling, distortion and / or discolouration on the finished or exposed surface. Plug, puddle or spotwelding are not permitted. If weld beads are shown on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

4) Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of AWS Specification D1.0-46.

a) Dirt grease, lubricant, or other organic material shall be removed by vapour degreasing or suitable solvent.

b) Joints rejected because of welding defects may be repaired only by rewelding. Defective welds shall be removed by chipping or machining.

Flame cutting shall not be used.

5) Wherever welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

6) All welds shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all welds conform to the designated type, size, spacing etc.

15.21.10 Soldering

All soldering and/or brazing shall be done as recommended by the suppliers of the metals involved.

15.21.11 Shop painting of Carbon Steel

Item of carbon steel, unless galvanised or scheduled for other finish, shall be thoroughly cleaned of all loose scale, filings, dirt and other foreign matter and shall be painted with zinc chromate primer.

15.21.12 Factory Application
As much work as possible shall be carried out in the factory. All glazing shall be done in the factory. Gaskets shall be pre-positioned and welded in the factory as far as possible. Site work shall be kept to a minimum.

15.22 GENERAL EXECUTION

15.22.1 The drawings supplied by the Consultant shall be considered essentially schematic, except of profiles of exposed surfaces which shall be as indicated. If, in the opinion of the contractor, a change of profile is required in order to meet the specifications, he shall consult the Consultant for a review of the conditions.

15.22.2 The method of assembling, reinforcing and anchorage of the aluminum structural cladding system, as indicated is schematic. Location and method of providing the same shall be the Contractor’s responsibility, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner complying with main building structure. Site work shall be coordinated with the overall programme.

15.22.3 All visible joints shall be as shown on the Consultant’s drawings.

15.22.4 All parts shall be secured by concealed means and screws exposed to view shall not be allowed.

15.22.5 All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in a manner not restricting thermal or wind movement of the metal wall cladding /curtain walling system. Where possible, sealants shall be concealed.

15.22.6 Free and noiseless movement of all components of aluminum structural glazing and cladding system due to thermal, structural, wind pressure, or dead loads shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.

15.22.7 The entire aluminum structural glazing and cladding system shall be assembled and installed so that all leakage and condensation shall be drained and discharged to the exterior face of the wall.

15.22.8 Movement of water behind and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapping water.

15.22.9 Measurements:
The measurements given on Consultant’s drawings shall not be used by the Contractor for preparing his shop drawings and for executing the work. All dimensions shall be actually measured at site and in case of any discrepancy between measurements on site and in drawings, modules shall be decided in consultation with the Consultant and Engineer-in-Charge.
15.23 PRE-CONSTRUCTION LABORATORY PERFORMANCE TESTING.
15.23.1 General
Specification 24.1 to 24.7 shall apply and the Contractor is required to carry out performance tests in laboratory condition at one of the approved test laboratories at his own cost. The performance mock-up are full-size representative portion of the proposed exterior wall system built to study construction details, test for the whole system meeting the performance specification for weather, structural load and movements.

The Contractor shall carry out on site water penetration test at locations as specified in clause 24.8 at his own cost. The contractor shall produce Mock-up Elevation, construction detail drawings etc. for the structural glazed curtain wall mock-up test units and submit to Engineer-in-Charge for the final approval. The Contractor shall forward the copies of approved mockup elevation and shop drawings and test parameters to the Test Laboratory prior to installation of the test units. These drawings shall include:

- Test elevation and sections showing bracket spanning.
- Full scale typical details of unitized panels (intersections of members).
- Typical support details and spanning.
- Extent & type of sealants: weather and structural sealants.
- Pressure equalization and Drainage system in each panel with size.
- Blanking off details and spandrel panel pressure release.
- Openable vent details with multipoint locking positions.
- Method of installation.

Any deviations from the drawings shall agreed upon before commencement and recorded in the final test report. Contractor shall install the mock-up in line with the approved drawings and with the same supervision and installation work force.

15.23.2 Test Units
1) The test units shall comprise of components and full size representative portion of the proposed exterior wall system under examination. The width of the test sample shall be not less than three typical elements / units. The height of the test sample shall be not less than 2 storey high and must contain full height modules of the proposed structural glazing system. Vertical and horizontal movement joints shall be included in the test sample.

2) Critical details of the building facade which differ from those in the representative test sample, such critical inward and outward building corners, overhangs, coping seal at roof level and similar supplementary on site test for water tightness shall be performed on such part of the facade.

3) The materials and components of the test sample (glass thickness, size and strength, aluminum profiles, bracket spanning, sealant, gaskets, accessories etc.) shall be of the same, type and size and have the same details, methods of construction, flashing and anchorage as that of proposed on the building facade.

4) The cost of entire testing shall be borne by the Contractor.
5) The test sample shall be mounted and sealed into a simulated building frame in the manner and by
the same fixing which are intended to attach the facade to the building structure. The support frame if not
same but shall be of equivalent stiffness to that supporting the building to prevent unrealistic deflection of
the prototype sample.

6) Simulated floor slabs and spandrel shall be to actual depth as of site condition with the air seal
connected to the slab. The air seal of the test sample shall be continued to the air seal of the test
chamber.

7) All Unitized mock-up panels in the facade shall be sealed at the test chamber boundaries. This is to
minimize the effects that the surrounding construction will have on the test performance of the sample.
All pressure equalization and drainage slots or holes in the test sample shall be left open.

8) Transparent viewing panels shall be provided so that the performance of the façade in areas that are
not readily seen can be determined.

15.23.3 Inspection of test units

1) The Contractor shall allow for the Consultant’s / Employer’s representative to inspect the test sample
during erection. At this stage the adequacy and stiffness of the support structure shall be assessed.
When the installation of the test sample is complete, the Consultant’s / Engineer-in-charge
representative shall inspect the test sample and if satisfied, shall approve its completeness in writing.
2) Testing shall commence only after obtaining the written approval as referred above.
3) Full time supervision of the contractor shall be provided for the erection of the test
unit and all thru testing of the test units.

15.23.4 TEST SEQUENCE- TEST PRESSURES
Prior to testing operable windows and doors need to be unlocked, fully opened, closed in the mockup for
minimum of 5 cycles. If any repairs or corrections are made, the above cycle should be repeated for 5
times.

1) Air Infiltration Test (ASTM E-283)

Method :
The test shall be conducted at 300 Pa pressure.
The test chamber leakages shall be calculated by attaching air tight seal of polythene sheet to the face of
the curtain wall with the tape and seal all around and applying Positive, negative pressures of 300 Pa to
measure the air infiltration rate through the test apparatus by calibrated flow meter placed in the test
chamber air line. Now sealing film or tape shall be removed from the test sample and the total air
infiltration through the test sample and the chamber shall be recorded. The difference between the total
leakages and the chamber leakage shall be the leakage of test sample.
Evaluation : Permissible air leakage shall be: 0.25 m3/hr/m2 for fix area and 1.0 m3/hr/mtr crack length
of operable panel.
2) Test Water tightness (Static pressure)
Method:
The differential air pressure for the test shall be 600 Pa. Water shall be sprinkled on the test unit at 3.4 L/m2-Min. The air pressure differential need to be applied within 15 seconds - negative pressure of 600 Pa shall be maintained continuously for 15 minutes before the pressure is turned to zero and the water spray should be stopped.
Observation:
All water leakage and drainage system at the joints and ventilators of the Curtain Walling System shall be observed from the inside of the chamber.
Evaluation: If water observed in the operable vent drainage path and the same is drained through drain slots after the spray is stopped it shall be considered as pass. Any uncontrolled water in excess of 15 ml or more on the top surface of any exposed interior shall be considered as leakage. In case of leakage the remedy needs to be carried out and the retest shall be conducted.
3) Test of Water tightness (Dynamic pressure)
Method:
This test shall be performed upon completion of the test for water penetration by static pressure. The Dynamic water penetration test should not commence within thirty (30) minutes of the static water penetration test. Maintaining the wind flow with the help of wind generating device, wind speed shall be adjusted to 31.28 m/sec, water shall be sprayed on the complete face of the test specimen at the rate of 3.4 Ltr/m2-Min. The spray shall be maintained for a period of not less than 15 min.
Observation:
Observation of the internal face of the facade shall be carried out during the water spray operation and for five (5) minutes after the water spray has stopped and there is zero air pressure difference on the facade. Any water appearing on the inside face of the facade shall be recorded, with the extent and, if possible, the source of leakage indicated.
Evaluation:
There shall be no leaks at the peak pressure equal to 600 Pa static positive pressure. A leak is considered to occur when:
 a) Water appears on the inside face of the facade and is visible from an occupied space in excess of 15 ml of water or
 b) Uncontrolled water appears on the inside face of the facade and is likely to damage insulation or other Architectural fixtures.
 c) Uncontrolled water is defined as any leakage that is not contained and drained away within the test duration (including the five (5) minutes observation period) in excess of 15 ml of water.
4) Test of Wind Resistance under static pressure
Method:
The equivalent load for wind pressure or wind suction shall be given to the test unit as increasing and
decreasing the inside pressure of the “Pressure Chamber” at which the test unit is fixed. Static Wind
Pressure: The static pressure shall be increased to a maximum of + 215 Kg/sq.m. in steps.
Observation: Deflection on each observational point of the test unit shall be observed and recorded
under the static pressure as described above.
Evaluation: No damage or harmful permanent deformation on any parts shall be found at the maximum
design wind pressure. as defined in item 24.4. The deflection of the main structural members in this
condition shall be as follows:
a) Mullions less than L/175 in case of single glass and L/240 in case of double glass (L = length between
support) or less than 15 mm whichever is less.
b) Transoms Less than L/300 (L = length between support) or less than 15 mm whichever is less. No
damage or harmful permanent deformation of any parts excepts sealing materials shall be found at the
maximum testing pressure. The maximum deflection / span ratio of glass shall not exceed 1: 90. The
residual displacement of a member shall not exceed L/1000. The slippage at supports and fixing shall not
exceed 1.0 mm.

5) Seismic Racking test
Method : The floor beam shall be subjected to 3 cycles of Lateral Displacement up to the value of 0.4%
of floor height with no time restrictions. First the beam will be jacked To one direction to the maximum
limit of the Displacement and released to allow the system to come Back to its original position. The
beam is than jacked to other direction to the maximum limit and released. Like Wise 3 cycles are
repeated.
Observation :
The observation team is placed inside and outside The specimen is to be observed for any sudden
effects of Jacking.
Evaluation :
No glass breakage or fall out is allowed. Any damage shall be easily repairable without any part
replacements required. No wall component fallout is allowed.

6) Repeat Air test :
Same as described under air infiltration test with static pressure.

7) Repeat Water test static : Repeat the water penetration test under static pressure.

8) Proof test
Method : The test sample shall be subjected to proof tests. The applied positive and negative pressure
shall be 1.5 times the designed wind pressure. Each proof test pressure shall be maintained on the test
sample for a period of 10 seconds at peak pressure and released to zero.
Evaluation: Under proof test there shall be no collapse shall mean any one or any combination of the followings:

a) Dislodgment of any glass.
b) Dislodgment of any frame, panel or any thereof.
c) Failure of any fixings that connect the façade to the building structure, such that the test sample is unstable.
d) Failure of any stop, locking device, fastener or support which would allow an opening light to come open.
e) The permanent deformation in framing members in excess of L/1000 is not permissible and considered as failure.

15.23.5 Form of Report
Details of the test sample (including an outline of the simulated building frame) and the test apparatus, instrumentation and method shall be clearly given in a report. The report shall include the following:

a) An identification and general description of the facade and Certificate of Identity from the contractor.
b) Drawings of the actual test sample showing modifications, if any.
c) Test sequence with pressure used in all tests.
d) Location of all transducers for the structural performance test.
e) Displacements, span/deflection ratios and air infiltration rates.
f) Other pertinent observations.

15.23.6 Record Drawings
1) The testing laboratory shall keep a copy of approved test unit, shop drawings and calculations at testing laboratory accurately and neatly recorded on the above mentioned shop drawings with all changes, revisions, modifications, etc. made to test unit, which shall become the record drawings.
2) On completion of testing and after approval of test reports, the testing laboratory shall submit the marked up record drawings to the Project Consultant.

15.23.7 Cost of Performance Testing
The cost of testing at the approved lab shall be payable by the contractor as per relevant item as indicated in the Bill /Schedule of Quantities. Testing shall include for the test chamber, support structure for the test, cost of fabrication, erection, corrections to and the demolition of the test unit. If the test unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the test unit and shall have the Test unit re-tested by the Testing laboratory until it passes the test. The rate shall also include for cost of correction to the test unit and cost of re-testing and no additional cost shall be payable in this regard.
15.23.8 Site Tests
The Contractor shall carry out site tests at his own cost to determine resistance to water leakage as per recommendations given in AAMA 501.2-94 and relevant Bureau of Indian standards for “Field Check of Metal Storefronts, Curtain Walls and Sloped Glazing Systems for Water Leakage”. The test areas shall be selected by the Consultant, one for every 600 sq.m. approx. of installed curtain wall and glazing system. Testing will normally be ordered on Lower floors but the Consultant may at his discretion order tests to be carried out on any upper floor. In case of any test failing, the Consultant shall order more tests to be conducted at the Contractor’s cost. Each test area shall be:

   a) 10 sqm. minimum or
   b) 25 m. Run of perimeter of vision and spandrel units
   c) 4 entire panels of standard types, whichever is the least.

15.24 INSTALLATION

15.24.1 Qualification of workmanship
All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed References and Standards. The qualification of the Contractor’s installation workmen shall first be filled with and approved by the Consultant.

15.24.2 Setting out
Bench marks for elevations and building line offset marks for alignment shall be established on each floor level by the contractor. Should any error be found in their location, the Contractor shall notify the Consultant in writing and installation work shall not proceed in the affected area until the errors have been corrected.

The Contractor shall submit the structural glazing anchorage plan for endorsement by the Consultant. The Contractor shall co-ordinate his system of anchorage according to site conditions.

15.24.3 Prior Inspection of the Structure
After the setting out has been established and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the curtain walling system/metal wall cladding are to be placed in that area. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the Consultant and Engineer-in-Charge. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the Consultant and Engineer-in-Charge.

15.24.4 Workmanship
All parts of the aluminum structural glazing and cladding system shall be erected true to plumb and in proper alignment and relation to established setting out, as shown on approved shop drawings.
15.24.5 Erection Tolerances
The installed metal wall cladding/curtain walling system components shall conform to the following erection tolerances under no-wind conditions:

a) Amount of total deviation and/or misalignment in any direction for vertical members:
   3 mm maximum in a height of 4 m (non-cumulative) and maximum 7 mm in full-height of cladding/curtain walling.

b) Amount of total deviation and/or misalignment in any direction for horizontal members:
   3 mm maximum in a length of 7 m. 5 mm in full length.

c) Maximum offset from true alignment between two butting members shall be 1 mm. No edge projection or misalignment will be permitted.

d) Maximum joints, gaps or openings between removable glazing stop and adjacent member shall be 1 mm and/or a maximum 1 mm cumulative opening at both ends of removable members (0.5 mm each end).

e) Deviation in spacing of brackets + 3 mm.

f) Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal and erection) must be made to ensure a workmanlike installation. The documentation and distribution of this information to all applicable installation and inspection personnel is essential in order to ensure the standard of quality and workmanship required.

15.24.6 Installation within and/or adjacent to concrete: Where work is to be installed within and/or adjacent to concrete, no aluminum structural glazing and cladding system components other than built in anchor devices shall be put in place until the concrete work is completed, including the removal of all forms, shoring, etc.

15.24.7 Anchorage: See clause 12.5 (2) and 20.9.

a) Anchorage of the aluminum structural glazing and cladding system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the aluminum structural glazing and cladding system are properly positioned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means.

b) All anchorage assemblies and their related components shall be thoroughly scheduled and described on the shop drawings so that anyone can evaluate an installation and ensure its compliance with the contract documents. Descriptive items shall include the access removal movement and tolerances of related building and the aluminum structural glazing and cladding system, direction and magnitude of thermal expansion, materials, sizes, quantities and any special instruction as may be required. All primary aluminum structural glazing and cladding, anchorage assemblies inclusive of frame/structural mullion shall receive a 100% inspection.

15.24.8 Welding

All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt area in prime coated surfaces shall be thoroughly cleaned and
painted with one coat of primer. Welds in galvanised steel shall be coated with one coat of zinc rich paint. Special care shall be taken to protect glass and other furnished surfaces from damage and to prevent causing fires.

15.24.9 Use of sealing materials
a) Sealing materials shall be used in strict accordance with the Manufacturer’s printed instructions and shall be applied only by workmen specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces it will be in contact with. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

b) The manufacturer(s) of the applicable materials shall, when required render technical assistance prior to the application of any sealant and witness the first applications as well as periodic site inspections thereafter. The contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen used to apply the sealant.

15.24.10 Coping and soffit trimmer
Installation of coping and soffit panels and field sealing between the copings and other trades shall be performed by the Contractor.

15.24.11 Tensioning of Bolts
All bolts shall be correctly tensioned. The tension shall be specified on shop drawings. At least 10% of bolts shall be mechanically checked for corrected tension.

15.24.12 Sequence of Installation
If so directed by the Consultant or Engineer-in-Charge, installation of the aluminum structural glazing and cladding shall be postponed in areas as designated by the Consultant or Engineer-in-Charge for a specified period of time so as to facilitate moving materials/equipment into and out of the building and installation of M&E (Mechanical & Electrical) fittings during construction. The Contractor’s work is to proceed along guidelines and schedule as directed by the Engineer-in-Charge.

15.24.13 Removal of Debris
All debris caused by or incidental to the installation work shall be promptly removed from the job site as the work progresses. Weep holes and drainage channels shall be unobstructed and free of dirt, rubbish and sealant.

15.24.14 Protection and Cleaning
a) The Contractor shall adequately protect all aluminum sections, glazing, cladding sheets, components and accessories from damage during shipment, storage, erection and after completion of the work by use of protective film/foil of approved non-staining quality,

b) At such time as may be directed by the Consultant, the Contractor shall remove all protective coverings and/or coatings and clean surfaces free of all soil and discoloration. Only those cleaning agents that are acceptable to the applicable aluminum, glass and coating manufacturers shall be used and where doubt exists, spot tests shall be made to satisfy the Consultant and Engineer-in-Charge.
16.0 INTERIOR WORKS

16.1 GENERAL
This Specification is for work to be done, items to be supplied and materials to be used in the works as shown in the schedule of work and defined on the drawings and described herein, all under supervision and upto the satisfaction of the client. The specification given under is General Specifications and shall be applicable to relevant items specified in the tender schedule. In case of brought out items where the model number is mentioned the manufacturer’s specifications shall be valid.

The workmanship is to be the best available and of high standards in all aspects of the work.

The materials and items to be provided by the Contractor shall be approved by the client in accordance with any samples which will be submitted for approval by Contractor and generally in accordance with the Specifications. Also if products are specified in the Specification and/or bill of brand, trade name or catalogue reference, the Contractor will be required to obtain the approval of the client before using the materials. The Contractor shall produce all invoices, vouchers or receipts for any material if called upon to do so by the client.

Samples of all materials are to be submitted to the client for approval before the Contractor orders or deliver the materials at site. Samples together with their packing are to be provided free of charge by the Contractor and should any materials be rejected, they shall be removed from the site at the Contractor’s expense. All samples will be retained by the client for comparison with materials which will be delivered at the site. Also, the Contractor will be required to submit specimen finishes of colours, fabrics etc. for the approval of the client before proceeding with the work.

The contractor shall be responsible for providing and maintaining and boxing or other temporary coverage’s required for the protection of dresses or finished work. He is also required to clean out all shelving, out ends and other waste from all pairs of the works before coverings or in-fillings are constructed.

Templates, boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate during the time they are in use. All unexposed surface of timber e.g. false ceiling, backing fillets, backs of door frames, cupboard framing, grounds, etc. are to be treated with two coats of approved timber preservative before fixing or converging. Only first class workmanship will be accepted. Contractor shall maintain uniform quality and consistency in workmanship throughout.

16.2 JOINERY
16. 2.1 Joinery is to be prepared immediately after the placing and framing, and then subsequently bonded and wedged up. Any portions that are warped or found with other defects are to be replaced before wedging up. The whole of the work is to be framed and finished in a manner in accordance with
the detailed drawings and whenever required, fitted with all necessary metal ties, straps, belts, screws, glue etc. Running beaded joints are to be cross tongued with teak tongues. Joinery work is generally to be finished with fine sand/glass paper.

16.2.2 JOINTS
All joints shall be standard mortise and tenon, dowel, dovetail, and cross halved. Nailed or glued butt joints will not be permitted. Where there are screws on a finished surface, the same will be sunk and the whole assembly being plugged with wood plug of the same wood and grain of the finished surface and the hole filled with wood filler to match the colour.

In event of joints opening in joiner's work open, or other defects arising, such defective joinery shall be taken down, and refilled, redecorated and/or replaced if necessary and any work disturbed shall be made good at the Contractor's expense. Nails, spikes and bolts shall be of lengths and weights approved by the client. Nails shall comply with IS 1959-1960. Brass headed nails are to comply with B.S.1210. Wire staples shall comply with B.S.1494 or equivalent.
The contact surface of dowels, tendons, wedges etc., shall be glued with an approved adhesive. Where joinery and carpentry works are likely to come into contact with moisture, the glue shall be of waterproof grade.

16.3 HARDWARE AND METALS
The hardware throughout shall be of approved manufacture or supplier; should be well made and equal in every respect to the samples to be deposited with the client. The Contractor may be required to produce and provide samples from many different sources before the client takes decision.
Fittings generally shall be brass polished & lacquered, unless otherwise specified and shall be suitable for their intended purpose. In any case, it will have to be approved by client before the Contractor procures it at site of work.

Screws are to match the finish of the article to be fixed, and to be round or flat headed or counter sunk as required. The contractor should cover up and protect the brass and bronze surfaces with thick grease or other suitable productive material, renew as necessary and subsequently clean off the same on completion.
Aluminium and stainless steel shall be of approved manufacture and suitable for its particular application. Generally the surface of aluminium shall have an anodized finish and both shall comply with the samples approved by the client. All stainless steel sheets shall be 304 SS Japan or equivalent with gauge as specified but not thinner than 16 G.
All steel, brass, bronze, aluminium and stainless steel articles shall be subjected to a reasonable test for strength, if so, required by the client at the Contractor's expense. All brazing and welds are to be executed in a clean and smooth manner rubbed down and left in the flattest and tidiest way, particularly
where exposed. Chromium plating shall be in accordance with I.S. Standard or as per approved specification for normal outdoor conditions and shall be on a base material of copper or brass.

16.4 GLAZIER

All glass to be of approved manufacturer complying with I.S. 3548-1966 as per approved quality and sample to be of the selective qualities specified and free from bubbles, smoke, air holes and other defects. Polished plate glass shall be "glazing glass" (G.G.) conforming to IS 3438-1965 or as per approved sample and quality. The compound for glazing to metal is to be a special non hardening compound manufactured for the purpose and of a brand and quality approved by the client.

While cutting glass, proper allowance shall be made for expansion. Each square of glazing should be in one whole sheet. On completion of work clean all glass should be cleaned inside and out, all cracked, scratched and broken panes to be replaced.

16.5 PAINTS & POLISHES

All material required for the works shall be of specified and approved manufacturer, delivered to the site in the manufacturer's containers with the seals etc., unbroken and clearly marked with the manufacturer's name or trade mark with a description of the contents and colour. All materials are to be stored on the site of the work.

Spray painting with approved machines will be permitted only if written approval has been obtained from the client prior to painting. The buzzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the client. The paint used for spraying is to comply generally with the specification concerned and is to be specially prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.

Impregnating wood preservative shall be Bison or equivalent and approved impregnating wood preservative and all concealed wood work shall be treated with wood preservative. All brushes, tools, pots, kettles etc. used in carrying out the work shall be clean and free from foreign matter and are to be thoroughly cleaned out before being used for a different type of class of materials.

All iron or steel surfaces shall be thoroughly scraped and rubbed with wire brushes and shall be entirely free from rust, mill scale etc. before applying the priming coat. Surfaces of new wood work which to be painted are to be rubbed down, cleaned, up to the satisfaction of the client.

Surfaces of previously painted woodwork are to be cleaned down with soap and water, detergent solution or approved solvent to remove dirt, grease etc. While wet, the surfaces shall be flattened down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed by scraping back to a firm edge and the exposed surface touched in with primer as described and stopped with putty.

16.6 POLISH

16.6.1 FRENCH POLISH

The basic material shall be shellac dissolved in methylated spirit.
Preparation:- The timber must be sanded and cleaned and the grain filled with a grain filler. Any staining must be done before applying the polish.

Equipment :- The polishing shall consist of a pad of cotton wool, which acts as a reservoir for the polish, and a cover of soft white linen or cotton fabric, similar to a well-worn handkerchief which acts as a fitter. The rubber must never be dipped into the polish; it should be changed by pouring the polish on to the pad with the cover removed.

Application:- Work evenly over the surface until the timber is coated with a thin layer of polish. The objective is to apply a series of thin coats, allowing only a few minutes for drying between the coats. When a level and even-boiled surface is obtained the work is ready for the second stage i.e. spiriting off. Allow the work to stand for at least eight hours then take a fresh rubber with a double thickness of cover material and charge it with methylated spirit. Work in the direction of the grain and continue until the surface is free from smears and rubber marks then leave to harden off.

16.6.2 WAX POLISH

Preparation:- Wax polish shall contain silicones and driers. A good silicon wax is to be used. The timber shall be sealed first with another finish such as Ronseal, before applying the wax.

Application:- Apply a light coat of the sealer by brush or cloth direct to the unfilled timber, working it well and finishing evenly with the grain. Allow to dry thoroughly and then sand lightly with fine abrasive paper. Apply a heavy coat of wax by cloth or on flat surfaces, with a stiff brush. Work it well into timber and finish off by stroking with the grain before leaving to harden. Leave for several hours before rubbing up with a soft brush. Finally; buff the grain with a soft cloth. Transparent Colored Polyurethane (Melamine) shall be applied where natural grain of the wood is required. Polyurethane produces as tough surface which resist chipping, scratching and boiling water.

Clean off all grease and wax with an abrasive and white spirit. This should not be applied in humid conditions. Apply the first coat, preferably of clear hard glaze with a cloth pad. Leave this to dry for at least six hours, and then apply further coats with a paint brush. If you wait for longer than 24 hours between coats, rub down the previous coat with fine glass paper or a medium grade of steel wool. Obtain a Matt finish, if required by giving a final coat of clear Ronseal Matt coat.

16.7 TIMBER

Only seasoned New Burma Teak Wood or Sal Wood to be used. All the wood shall be properly seasoned, natural growth and shall be free from worm holes, loose or dead knots or other defects, saw die square and shall not suffer warping, ting or other defects. The moisture content shall not exceed 12%

All internal frame work shall be treated with approved wood preservative. All wood brought to site should be clean and shall not have any preservative. All rejected decayed, bad quality wood shall be immediately removed from site. All wood brought to site must be stacked-stored properly as per instructions.
16.8 PLYWOOD
Plywood/medium density fiber board/teak particle board/ Veneered board etc., as specified in the approved list of manufacturers shall only be used. Only Fire retardant type exterior grade Phenol formaldehyde bonded, hot pressed ply generally conforming to I.S.I. 5509 of approved make only to be used. Marine plywood shall generally conform to I.S.710-1980 and also to Defense/ Navy specification bonded, with phenol formaldehyde, treated with wood preservative.

16.9 CARPENTRY WORK
Providing and fixing in position Wood frame work for partitions upto true ceiling height, panelling, boxing, soffit with vertical members at not more than 600 mm centres and horizontal members not more than 600 mm centres complete including necessary additional supports, bracing runner etc. complete as per drawing and directions. Items are to be completed in all respects as per drawings & instructions from client. Rate to include applying of approved wood preservative on the finished frame work.

16.10 PANELLING / BOXING
The item of work consists of providing and fixing in position 12mm thick Fire-Retardant Plywood and to be completed in all respects as per drawing / instructions of EIC. The actual executed area is to be measured. The item also includes providing and fixing 8mm thick Glass in partition of approved make, of appropriate size as per drawings and design with necessary wooden mouldings / biddings to hold the glass in position. All exposed wooden surfaces has to be finished with 2/3 coats of melamine polish.

IMPORTANT NOTE: Actual executed area will be measured on one side of partition. Rate of this item shall include cost of providing fixing wooden facia, if any, matching laminate in approved pattern, skirting, Cornice Moulding at both door level and false ceiling level, Top Cap moulding in case of Low Height Partition etc. as per details and finished in melamine polish of wooden and veneered surfaces for which no extra payment shall be made but shall be measured along with the partition dimensions. The finishing material shall be fixed in required divisions/ panels/ pattern with proper grooves etc. as per drawings & directions. Item are to be completed in all respects as per drawings & instructions from Consultant.

17.0 LANDSCAPING & HORTICULTURE WORKS

17.1 SCOPE
The landscape contractor shall from the date of commencement of contract, furnish all materials, labor, and related items necessary to complete the work indicated and specified herein.

The scope of work for the above mentioned work shall include the following and shall be carried out as per BOQ, Specification & Landscaping Layout drawings.

The landscape contractor will be generally responsible for the entire site but in particular to works listed below. Along with site management, the responsibilities will include landscaping works and arboriculture works and maintaining the same.

After planting, all planted areas that have exposed soil will have to be mulched with straw or hay. Mulching will be evenly spread to cover any exposed soil.
In addition, the contractor will also be responsible for filling gaps, thinning and transplanting, or replanting where plants may need to be replaced. Along with other planting, the contractor will also be responsible for improving soil conditions for planting. This may include import/export of sand/soil to/from site. The contractor will also clear vacant area from existing grasses, keep the site clean and maintain the already planted areas free of weeds, pests or insects that cause diseases. All weeds, unwanted grasses and plant material will be cleared up to 1000mm from the edge of planting of newly created and already existing horticultural works (such as boundary trees). The contractor will also be responsible for protection of the plants from salt spray that may occur during the monsoons.

17.2 STORAGE SHED
No storage area will be provided at site by the Employer. As mentioned in General Conditions of Contract, security of materials at site will be the responsibility of the contractor. Any temporary sheds or structures may be built as working space at the area shown at site and on the approval of the Site Engineer.

17.3 WATERING
Water will be made available at only one source at site. If the water on site is insufficient or saline or unacceptable, then the contractor shall be responsible for importing water in water tankers for the general upkeep of the plants. No plants shall be allowed to wither or die due to lack of proper watering.

17.4 PLANT REQUIREMENTS
Plants and shrubs shall be sourced by the contractor from available nurseries, unless otherwise specified. Seeds shall be acquired from reputed organizations and hybrid seeds will be used where possible – particularly for flower varieties. No plant material shall be changed without the consent of the Consultant.

17.5 RESPONSIBILITY
a) The contractor’s work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor’s team to such utilities will be penalized and contractor shall be responsible for cost for such damages.
b) The contractor shall abide by the Security rules / procedures of the Employer, and shall obtain gate pass, issue I.D. badges to all their employees on site, etc. as prescribed by the Employer.

17.6 MATERIALS & LABOUR
All the materials which are required for the progress of the Landscaping works shall be supplied by the contractor. The required numbers of Labour are to be provided by the contractor.

17.7 PLANTING
Whenever planting, the following specifications will be followed by the contractor. Wherever sand is to be removed, the following specifications shall be followed after refilling the area with good soil.

17.7.1 DIGGING OF PITS
Tree pits of 600mm x 600 mm x 600 mm (approx. 2’x2’x2’) shall be dug a minimum of two weeks prior to back filling. The pits for shrubs shall be 600 mm in depth and 300mm diameter. For ground cover, the land will be prepared by digging up to 300 mm (1’) and soil loosened. While digging the pits the top soil may be kept aside, and mixed with the rest of the soil as specified.

If the soil quality is poor, it shall be replaced with soil mixture acceptable to the Consultant. If the soil quality is satisfactory, then it shall be mixed with manure and river sand. The soil condition will have to be approved by the Consultant. Pest/termite prevention chemicals or any other approved chemical to be applied into the soil before planting as per supplier’s specification. When planting is in more than one row, then pits will be dug in a zig-zag fashion ensuring a diagonal planting in each row.
17.7.2 PLANTING MIXTURE:
The topsoil will be mixed with 15% farm yard manure or coco-peat, 40% red soil, 20% river sand and 20%
excavated earth (topsoil). This mixture will be filled in pits before and after planting.

17.7.3 BACK FILLING:
The soil is back filled, watered thoroughly and gently pressed down a day previous to planting, to make
sure that it may not further settle down after planting.

17.7.4 PLANTING:
No tree pits shall be dug until a final tree position has been pegged out for approval. Care shall be taken
that the plant sapling when planted is not buried beyond the level of the pot containing it. Planting should
not be carried out in waterlogged soil.

17.7.5 STAKING:
If necessary, a single vertical stake 1 meter (approx. 3 ft) longer than the clear stem of the plant, driven
300 mm to 450 mm (approx.1ft to 1’6”) into the soil shall be used. Each plant should be secured to the
stake so as to prevent excess movement.

17.7.6 WATERING:
The landscape contractor shall allow for the adequate watering of all newly planted trees, shrubs and
groundcover immediately after planting and during the following growing season, shall keep the plant
material well watered.

17.7.7 MULCHING:
All planted areas including around trees which have open soil that is exposed will have to be mulched
with straw or hay. Rates indicated in the Bill of Quantities shall include such mulching costs. No separate
compensation will be paid for mulching.

17.7.8 PROTECTION:
The contractor will be responsible and should take measures to protect the planted saplings from cattle,
salt spray and high wind pressure. Rates indicated in the Bill of Quantities shall include such costs of
protecting the plants including any physical construction such as walls, tree guards, etc. that may be
required for the same.

17.8 LAWN

17.8.1 PREPARATION:
During period prior to planting the lawn, the area shall be maintained free from weeds, whatever the
nature of soil, complete surface shall be trenched over to a depth of 300 – 450 mm. Grading and final
levelling of the lawn shall be completed at least 2 weeks prior to the actual sowing.

17.8.2 SOIL
The soil itself shall be ensured to the satisfaction of Consultant to be a good fibrous loam, rich in humus.
Pest/termite prevention chemicals to be mixed if required. Top soil shall be mixed with farm yard manure
or coco-peat and mixed with river sand in ratio of 15% manure, 25% river sand, 35% red soil and 25%
excavated earth and leveled to maintain positive drainage or specified slopes.

17.8.3 EXECUTION
Nodes of specified grass shall be dilled not more than 50mm apart on above mentioned soil conditions.
Wherever specified, carpet lawn will used. The carpets will be laid next to each other in an even pattern
to ensure that all lawn area is covered. After laying of carpet, it should be lightly pressed into the ground
to ensure that it is does not shift, and to ascertain that the roots are in soil. Positive slopes will be
maintained to ensure that there will be no low lying areas in center where water logging or pools are
created.
17.8.4 MAINTENANCE
In the absence of rain, lawn shall be watered daily - heavily, soaking the soil thoroughly to a depth of at least 150 mm.

17.8.5 CUTTING
The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine.

17.8.6 EDGINGS
These shall be kept neat and must be cut regularly with the edging shears.

17.8.7 FERTILIZING
The lawn shall be fed once a month with liquid fertilizer by dissolving 45 gms of Ammonium Sulphate in 5 litres of water.

17.8.8 WEEDING
Prior to regular mowing, the contractor shall carefully remove unsightly weeds.

17.9 MAINTENANCE
Tenderer shall have to carry out annual maintenance for a period of 1 (one) year during 'Defects Liability period' Maintenance of all items as per BOQ should be for a period of 1 (One) year.

17.10 MEASUREMENT
The measurement for payment to the contractor will be item wise as mentioned in the schedule of works.

18.0 PAVER BLOCKS FOR PATHWAY
The compressive strength requirement of concrete paver block shall be minimum 47.2 MPa (N/sqmm) for 28 days (Testing as per IS-15658) after applying the correction factor as per IS-15658:2006. Testing certificate is to be submitted by the agency.

18.1. Paver Block Dimensions

<table>
<thead>
<tr>
<th>Thickness</th>
<th>80mm/60mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td>Regular (Uniform shape with no Hollow or Cracks)</td>
</tr>
<tr>
<td>Chamfer</td>
<td>5 mm to 7 mm along top edges</td>
</tr>
<tr>
<td>Thickness of Wearing Layer</td>
<td>Minimum 6 mm (The thickness of the wearing surface shall be measured at several points along the periphery of paver blocks. The arithmetic mean of the lowest two values shall be the minimum thickness of the wearing layer)</td>
</tr>
<tr>
<td>Colour</td>
<td>Natural cement Grey colour without use of any pigment OR colour as specified</td>
</tr>
<tr>
<td>Dimensional Tolerance</td>
<td>Tolerances as per IS-15658:2006</td>
</tr>
</tbody>
</table>

Note: All other visual/physical & dimensional acceptance on parameters like aspect ratio, squareness etc to be as per IS-15658:2006
18.2. Testing of Paver Blocks
i) FOR 80MM PAVER TILES

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>TEST</th>
<th>SPECIFICATION Average Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>28 day Compressive Strength</td>
<td>Minimum 47.2 MPa (N/Sqmm) (for 80mm)</td>
</tr>
<tr>
<td>2.</td>
<td>Abrasion Resistance</td>
<td>Maximum 2 mm [i.e. 10 units of 1000 mm3 per 5000 mm2 reported as per E-5 of Annex E of IS-15658:2000]</td>
</tr>
<tr>
<td>3.</td>
<td>Water Absorption</td>
<td>Avg. of 3 units - Maximum 6% by mass (restricted to 7% in individual test units)</td>
</tr>
</tbody>
</table>

ii) FOR 60MM GRASS PAVER TILES

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>TEST</th>
<th>SPECIFICATION Average Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>28 day Compressive Strength</td>
<td>Minimum 37.1 MPa (N/Sqmm) (restricted to 31.5 MPa in individual test units)</td>
</tr>
<tr>
<td>2.</td>
<td>Abrasion Resistance</td>
<td>Maximum 3 mm [i.e. 15 units of 1000 mm3 per 5000 mm2 reported as per E-5 of Annex E of IS-15658:2000]</td>
</tr>
<tr>
<td>3.</td>
<td>Water Absorption</td>
<td>Avg. of 3 units - Maximum 6% by mass (restricted to 7% in individual test units)</td>
</tr>
</tbody>
</table>

Sampling and Testing Procedure strictly As Per IS – 15658; 2006.

18.3. Laying of Paver Blocks

18.3.1 PRIMING
The contractor is required to verify the existing WBM driveway surface and ascertain the CBR value. Accordingly the total subgrade thickness required for achieving the desired CBR value shall be advised to NKDA within seven days of receipt of call-up. NKDA shall, through regular agencies arrange to carry out such WBM, wherever required. Before taking over the site, the contractor is required to verify the stabilization of the surface with CBR values. It will be the responsibility of the contractor to ensure that the Manholes / Pipeline / Cable trenches / circular drainage system etc. is raised to driveway level using the requisite materials as per instruction of EIC. The areas of potholes / deep depressions at the isolated locations shall be filled up and properly compacted before laying the paver blocks. No extra payment will be made for this purpose. The area of raised manholes shall be included in the measurement of overall area of paver blocks for the purpose of payment.

18.3.2 BEDDING SAND COURSE
The bedding sand shall consist of naturally occurring, clean, well graded sand passing through 4.75mm sieve and suitable to concrete manufacture. The bedding should be from either a single source or blended to achieve the following grading.

<table>
<thead>
<tr>
<th>IS SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.52mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75mm</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36mm</td>
<td>80-100</td>
</tr>
<tr>
<td>1.18mm</td>
<td>50-100</td>
</tr>
</tbody>
</table>
Contractor shall be responsible to ensure that single-sized, gap-graded sands or sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp, not rounded. The sand used for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence. The sand shall be of uniform moisture content, which shall be within 4% - 8%, at the time of spreading and shall be protected against rain when stockpiled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be as specified in the schedule and within 5mm. Thickness variation shall not be used to correct irregularities in the base course surface. The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following spreading. Any pre-compacted sand left overnight shall be loosened before further laying of paver blocks takes place. Sand shall be slightly spread in a loose condition to the predetermined depth only slightly ahead of the laying of the paver block. Any depressions in the spread sand exceeding 5mm shall be loosened, raked and re-spread before laying of paver block.

18.3.3 LAYING OF INTERLOCKING PAVER BLOCK:

Paver block shall be laid in pattern as specified in drawing throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not to be permitted in other than approved locations. Paving units shall be placed on the uncompacted sand bed to the nominated laying pattern and care shall be taken to maintain the specified bond throughout the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving units are permitted or edge units may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine. No haphazardly broken pavers shall be used. Paver block shall be placed with the help of spacers to achieve gaps nominally 2 to 3mm wide between adjacent paving joints. No joint shall be less than 2mm nor more than 4mm. **However it is mandatory to use 3.0mm wide spacer while laying paver tiles so as to ensure uniform 3.0mm gap between adjacent pavers.**

Frequent use of string lines shall be used to check alignment. In this regard, the “laying face” shall be checked at least every two metre as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with. In each row, all full units shall be laid first. Closure units shall be cut and fitted subsequently. Such closure units shall consist of not less than 25% of a full unit. To fill spaces between 25mm and 50mm wide, concrete having minimum 1:1:2 cement : sand : coarse aggregate mix and a strength of 40 N/Sqmm shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used.
Except where it is necessary to correct any minor variation occurring in the laying bond, the paver block shall not be hammered into position. Where adjustment of position is necessary.

18.3.4 INITIAL COMPACTION
After laying the paver block, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than two (2) passes of a suitable plate compactor. The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving units. Prior to compaction all debris shall be removed from the surface. Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one meter of the laying face. Compaction shall continue until lipping has been eliminated between adjoining units. Joints shall then be filled and recompacted as described in Clause 6.5.

All work further than one meter from the laying face shall be left fully compacted at the completion of each day’s laying. Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced. Sufficient plate compactors shall be available at the paving site for both bedding compaction and joint filling.

18.3.5 JOINT FILLING AND FINAL COMPACTION
As soon as practical after compaction and in any case prior to the termination of work on that day and prior to the acceptance of any traffic, sand for joint filling shall be spread over the pavement. Joint sand shall pass a 2.36mm (No. 8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits:

<table>
<thead>
<tr>
<th>IS SIEVE SIZE</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36mm</td>
<td>100</td>
</tr>
<tr>
<td>1.8mm</td>
<td>90-100</td>
</tr>
<tr>
<td>600mm</td>
<td>60-90</td>
</tr>
<tr>
<td>300 microns</td>
<td>30-60</td>
</tr>
<tr>
<td>150 microns</td>
<td>15-30</td>
</tr>
<tr>
<td>75 microns</td>
<td>10-20</td>
</tr>
</tbody>
</table>

The Contractor shall supply a sample of the jointing sand to be used in the contract prior to delivering any such material to site for incorporation into the works. Certificates of test results issued by a recognised testing laboratory confirming that the sand sample conforms to the requirements of this specification shall be submitted prior to supply of total volume required. The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) pass of the plate vibrator and joints refilled with sand to full depth. This procedure shall be repeated until all joints are completely filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted. Both the sand and paver block shall be dry when sand is spread and broomed into the joints to prevent premature setting of the sand.
The difference in level (lipping) between adjacent units shall not exceed 3mm with not more than 1% in any 3m X 3m area exceeding 2mm. Pavement portions which are deformed beyond above limits after final compaction, shall be taken out and relaid to the satisfaction of the Engineer in charge.

18.3.6 EDGE RESTRAINT USING KERB BLOCK

Edge restraints shall be done using the kerb blocks. They should be fixed properly to withstand overriding by the anticipated traffic, thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside of the laying course. The surface course should not be vibrated until the edge restraint, together with any bedding or concrete haunching, has gained sufficient strength. It is essential that edge restraints are adequately secured.

18.3.7 UNIFORM INTERLOCKING SPACES

The pavers should have uniform interlocking space of 2mm to 3mm to ensure compacted sand filling after vibration on the paver surface.

18.3.8 SKILLED LABOUR

Skilled labour should be employed for laying blocks to ensure line and level of pavers, desired shape of the surface and adequate compaction of the sand in the joints. The laying pattern should follow the drawings provided by employer.

Executive Engineer-I
New Town Kolkata Development Authority
<table>
<thead>
<tr>
<th>SI No.</th>
<th>Material</th>
<th>Approved supplier &amp; Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CEMENT</td>
<td>ULTRATECH/AMBUJA/ACC/LAFARGE</td>
</tr>
<tr>
<td>2</td>
<td>STEEL/REINFORCEMENT</td>
<td>TATA/SAIL/TISCO/ SRMB/ELEGANT</td>
</tr>
<tr>
<td>3</td>
<td>VITRIFIED TILES</td>
<td>SOMANY/KAJARIA PLUS</td>
</tr>
<tr>
<td>4</td>
<td>CERAMIC TILES</td>
<td>SOMANY/KAJARIA/JHONSON</td>
</tr>
<tr>
<td>5</td>
<td>CEMENT CONCRETE TILES</td>
<td>ULTRA/EUROCON</td>
</tr>
<tr>
<td>6</td>
<td>WATER PROOFING COMPOUND</td>
<td>SIKI/PLASTOCRETE/CICO SUPAPLAST</td>
</tr>
<tr>
<td>7</td>
<td>GLASS</td>
<td>MODIFLOAT/SAINTOGBAIN/PILKINGTON</td>
</tr>
<tr>
<td>8</td>
<td>PLASTER OF PARIS / PUTTY</td>
<td>BIRLA/JK</td>
</tr>
<tr>
<td>9</td>
<td>ALUMINIUM SECTIONS</td>
<td>JINDAL/INDAL/BECO</td>
</tr>
<tr>
<td>10</td>
<td>FALSE CEILING</td>
<td>ARMSTRONG/EVEREST</td>
</tr>
<tr>
<td>11</td>
<td>ADHESIVE</td>
<td>FEVICOL/PIDILITE</td>
</tr>
<tr>
<td>12</td>
<td>BLINDS</td>
<td>VISTA LEVOR/MAC</td>
</tr>
<tr>
<td>13</td>
<td>FLUSH DOOR</td>
<td>GREEN/CENTURY</td>
</tr>
<tr>
<td>14</td>
<td>BLOCK BOARD &amp; PLYWOOD</td>
<td>GREEN/CENTURY</td>
</tr>
<tr>
<td>15</td>
<td>LAMINATES &amp; VENEER</td>
<td>GREEN/CENTURY</td>
</tr>
<tr>
<td>16</td>
<td>LOCKS</td>
<td>GODREJ</td>
</tr>
<tr>
<td>17</td>
<td>HARDWARES</td>
<td>EARLBHARI/DORMA/HAFELLE/GEZE</td>
</tr>
<tr>
<td>18</td>
<td>CEMENT CONCRETE PIPES</td>
<td>INDIAN HUME PIPE/MM METAL &amp; CO</td>
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<td>19</td>
<td>DOOR CLOSER</td>
<td>DORMA/HAFELLE/HARDWYN</td>
</tr>
<tr>
<td>20</td>
<td>PVC DOOR</td>
<td>SINTEX/DURO PLAST</td>
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<tr>
<td>21</td>
<td>ALUMINIUM WINDOW</td>
<td>WINTEK/FENESTA</td>
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<td>22</td>
<td>STEEL SECTION</td>
<td>TATA/JINDAL/SAIL</td>
</tr>
<tr>
<td>23</td>
<td>ACP CLADDING</td>
<td>ALSSTONE/ALUDECOR/ALSTRONG</td>
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<tr>
<td>24</td>
<td>PAVER BLOCK</td>
<td>TUFFSTONE</td>
</tr>
<tr>
<td>25</td>
<td>GALVANIUM SHEET</td>
<td>G.E PLASTICS/TATA BLUESCOPE</td>
</tr>
<tr>
<td>26</td>
<td>WALL PAPER</td>
<td>MARSHALL</td>
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<tr>
<td>27</td>
<td>PVC DRAIN CELL</td>
<td>DUPOINT</td>
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<td>28</td>
<td>STAINLESS STEEL HANDRAIL</td>
<td>KITCH/SHYAM STEEL/NEKI INDIA</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Supplier(s)</td>
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<tr>
<td>---</td>
<td>------------------------------------------</td>
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<tr>
<td>29</td>
<td>TOILET MODULAR PARTITION</td>
<td>BESCO MERINO</td>
</tr>
<tr>
<td>30</td>
<td>FLOOR CARPET</td>
<td>SHAW CARPET / AHUJA CARPET / SKIPPER</td>
</tr>
<tr>
<td>31</td>
<td>POLYCARBONATE SHEET</td>
<td>GE lexan / TATA Bluescope</td>
</tr>
<tr>
<td>32</td>
<td>MODULAR FURNITURE</td>
<td>GODREJ / PHOENIX MACHINE</td>
</tr>
<tr>
<td>33</td>
<td>ANCHOR FASTENER, DUCT SEAL</td>
<td>HILTI</td>
</tr>
<tr>
<td>34</td>
<td>FIRE RATED DOOR</td>
<td>KHEMKA TIMBER / S &amp; T ENTERPRISE / PROMATE</td>
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<tr>
<td>35</td>
<td>RUST REMOVING AGENT</td>
<td>SIK A RUST OFF</td>
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<td>36</td>
<td>BONDING AGENT</td>
<td>SIK A HIGH BOND / CICO BOND EPO</td>
</tr>
<tr>
<td>37</td>
<td>PARTICLE BOARD</td>
<td>CENTURY / ALISHAN</td>
</tr>
<tr>
<td>38</td>
<td>EPOXY GROUT FOR FILLING TILE JOINT</td>
<td>SIK A T ILOGROUT / LATAPOXY SP-100</td>
</tr>
<tr>
<td>39</td>
<td>ACCOUSTIC PANELS &amp; BOARD</td>
<td>AMSTRONG / ANUTONE</td>
</tr>
<tr>
<td>40</td>
<td>MEDIUM DENSITY FIBRE BOARD</td>
<td>CENTURY / NU WOOD</td>
</tr>
<tr>
<td>41</td>
<td>PAINT (SYNTHETIC ENAMEL)</td>
<td>DULUX GLOSS / LUXOL / SUPERLAC HIGH GLOSS / APCOLITE</td>
</tr>
<tr>
<td>42</td>
<td>INTERIOR ACRYLIC EMULSION LUXERY</td>
<td>ICI VELVET TOUCH / BERGER SILK / ROYAL LUXURY EMULSION</td>
</tr>
<tr>
<td>43</td>
<td>EXTERIOR ACRYLIC EMULSION 100% Acrylic</td>
<td>WEATHER SHILD MAX / APEX ULTIMA</td>
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<tr>
<td>44</td>
<td>EPDM</td>
<td>AMEE Rubber industries Pvt. Ltd, Bohra Rubber</td>
</tr>
<tr>
<td>45</td>
<td>FIBRE GLASS WOOL</td>
<td>U.P. Twiga Fibreglass Limited, Lloyd Industries (India) Ltd.</td>
</tr>
<tr>
<td>46</td>
<td>ROCK WOOL</td>
<td>Vetrotext Industries India Private Limited. Lloyd Insulations (India) Limited</td>
</tr>
<tr>
<td>47</td>
<td>SILICON SEALANT</td>
<td>Dow Corning, GE</td>
</tr>
</tbody>
</table>

Executive Engineer-I
New Town Kolkata Development Authority
## SECTION –C

### SPECIFICATION WATER SUPPLY, SANITARY AND DRAINAGE SYSTEM

#### I. GENERAL:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

#### Plumbing Works:

<table>
<thead>
<tr>
<th>Item</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitreous Chinaware</td>
<td>2556 (Part - I)</td>
</tr>
<tr>
<td></td>
<td>2556 (Part - II)</td>
</tr>
<tr>
<td></td>
<td>2556 (Part - III)</td>
</tr>
<tr>
<td>Ball Valve</td>
<td>1703 - 1977</td>
</tr>
<tr>
<td>Cistern Brackets</td>
<td>775 - 1970</td>
</tr>
<tr>
<td>Toilet Seat Cover</td>
<td>2548 - 1983</td>
</tr>
<tr>
<td>Vitreous China Cistern</td>
<td>2326 - 1987</td>
</tr>
<tr>
<td>Sand Cast Iron Pipes and Fittings</td>
<td>1729 - 1979</td>
</tr>
<tr>
<td>Spun Cast Iron Pipes and Fittings</td>
<td>3989 - 1984</td>
</tr>
<tr>
<td>GI Pipes</td>
<td>1239 - 1979</td>
</tr>
<tr>
<td>Galvanizing for GI Pipes</td>
<td>4736 - 1986</td>
</tr>
<tr>
<td>Pipe Threads</td>
<td>554 - 1985</td>
</tr>
<tr>
<td>Malleable Iron Fittings</td>
<td>1879 - 1987</td>
</tr>
<tr>
<td>Cast Iron Sluice Valves</td>
<td>780 - 1984</td>
</tr>
<tr>
<td>Full Way Valves</td>
<td>778 - 1984</td>
</tr>
<tr>
<td>Brass Ferrule</td>
<td>2692 - 1978</td>
</tr>
<tr>
<td>Stone Ware Gully Trap</td>
<td>651 - 1980</td>
</tr>
<tr>
<td>RCC Pipes</td>
<td>458 - 1971</td>
</tr>
<tr>
<td>Cast Iron Class LA Pipes</td>
<td>1536 - 1989</td>
</tr>
</tbody>
</table>
1. The Contractor shall arrange with local Municipal Authorities for getting the water and Sewerage connections. The actual connection charges to be paid to the local bodies shall be borne by the Contractors.

2. No payment will be made to the Contractor for submission of plans to the statutory authorities / Local bodies etc. and obtaining sanction of the same. The rates quoted by the Contractor shall be considered and deemed to have been inclusive of all these charges that might have been incurred by the Contractor.

3. The rates are of complete items as fixed in position and over all costs- e.g. cutting of holes, chases, etc., and also for provision of fixing arrangement viz., clamps, brackets, wooden blocks priming, painting etc. the rates shall also include restoration to original condition of all damages to walls, floors etc., during the process of fixing sanitary installations, water supply and drainage. All debris of plumbers excavation etc., shall be removed without any extra charge. The plumbing work/or the building work effected by the plumber work shall be left thoroughly cleaned to the satisfaction of NKDA.

4. Unless specified, all material should conform to ISI specification and be of best quality and make as approved by the E.I.C. Testing shall be undertaken for various materials samples, pipe lines etc. and as may be directed by the E.I.C. at the risk & cost of the Contractor.

5. All G.I pipes (except concealed pipes and underground pipes) and brackets and fixtures and manhole covers shall be painted with 2 coats of synthetic enamel paints of approved brand over a coat of Red-oxide Primer/Red lead primer, as directed.

6. All concealed and underground G.I pipes and specials shall be painted with 2 coats of Bituminous paint of approved brand as directed by the E.I.C.

7. All priming and painting work shall be carried out to the satisfaction of the E.I.C. and cost thereof shall be covered in the rates of all the respective items.
8. The Plumbers shall obtain the drainage completion certificate and the certificate of adequate water supply from the Local statutory body / Municipality and shall abide by the rules and regulations prescribed by them or other authorities concerned, wherever necessary.

9. In case of concealed G.I pipe work, the chases in floors and walls shall be made as approved by E.I.C. The pipes shall be secured tightly to the walls with clamps. The chases shall be filled with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20mm nominal size ). Payment shall be made for cutting chases and filling in the cement concrete and making them good as per relative item in the Bill of quantity for renewal items as per State P.W.D. specifications.

10. The cast iron pipes shall be laid exposed on wall with M.S. holder butt clamps made from 32mm thick. M.S. flats of approved design and required size. A clear minimum gap of 25mm between the wall and the pipe shall be left. All the clamps shall be embedded in cement concrete blocks sized 20cm x 20 x 10 cms. in 1:2:4 mix ( 1 cement :2 coarse sand : 4 graded stone aggregate - 20mm. nominal size ). The holes in walls and RCC work shall be made at point approved by E.I.C, and shall be made by the Contractors. Payment shall be made as per relative item in the Bill of Quantity complying with State P.W.D. specifications.

11. All plumbing and sanitary fixtures, pipes and pipe fittings, traps etc., which are to be embedded into the concrete or masonry work or other building work shall be placed in position and embedded for concealed at the time of casting of concrete during the work of construction. In case where chasing or cutting of concrete, masonry, or other structural or constructional work is unavoidable, the location of such fittings, pipe lines and traps etc., shall be chalked out at the various places and the cutting, chasing or disturbing of the construction work shall be proceeded only after the due approval of E.I.C.

12. All cuttings, chasing and fixing work shall be completed before commencement of any plastering, tiling or finishing work. Any rectification required shall be done at the risk & cost of the Contractor to the entire satisfaction of E.I.C.

13. Galvanized iron pipes of “TATA” or equivalent make, of “Medium” quality, E.R.W. as per IS – 1239, P-I; and Pipe Fittings shall be of “Heavy” quality, as per IS – 1239, P-II, of Galvanized Malleable Cast Iron, with Material code conforming to IS-1879 of “HB”, or “NB”, “Zoloto”, Leader, “JSI” or equivalent Brand. Test certificates from the manufacturer shall be submitted by the Contractors. Over & above the submission of test certificates, E.I.C. may also ask to the Contractor for further testing of samples in Govt. laboratories/test houses at the risk & cost of the Contractor.

14. **Samples:**

In all cases, samples of the materials proposed to be used shall be submitted for approval of the NKDA, before taking up the work in hand and the samples shall be well preserved at site by Contractor at his own risk & cost.
15. **Materials, Workmanship & Samples:**

All the materials and workmanship are to be of the best possible description and to the entire satisfaction of NKDA and the Contractors shall immediately remove from the site any materials and/or workmanship which, in the opinion of NKDA, is defective or unsuitable and shall substitute proper materials and/or workmanship forthwith at Contractor's risk & cost.

16. The Contractors shall, if required by the E.I.C., arrange to test material and/or portions of the works at his own cost in order to prove their soundness and efficiency, physical & chemical properties from Govt. laboratories/test houses. If after any such test, the work or portion of works is found in the opinion of the E.I.C., to be defective or unsound, the Contractor shall pull down and re-execute the same at his own cost. Defective materials shall be removed from the site within 7 days from receipt of such order at his risk & cost. No extra claim whatsoever shall be entertained by the E.I.C.

17. Wherever reference has been made to Indian Standard or CPWD specifications or any other specifications, the same shall mean to refer to the latest specifications irrespective of any particular edition of such specifications being mentioned in the specifications or schedule of quantities. **In case of any dispute, the decision of the E.I.C. shall be final & binding on the Contractor.**

18. The rates quoted shall be for all heights and depths.

19. **Bidders should note that the quantities in the Bill of quantities are approximate and are subject to variation upto any extent.**

20. This Technical specification shall be read in conjunction with other part/specification of the contract, viz. GCC etc.

21. The E.I.C. shall have the right to modify/change the working drawing even after issue to the Contractor.

II. **MATERIALS:**

**General:**

a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specifications.

b) A set of specification samples of all approved materials shall be kept well preserved at site, cost of which is to be borne by the Contractor.

1.0 **SANITARY WARES:**

All sanitary wares and fittings shall be of first class quality white vitreous China as manufactured by **Hardware**, or Parryware or Cera or equivalent brand approved by E.I.C. prior to the procurement by the Contractor.
Stainless steel sinks and draining board shall be of best quality stainless steel of “Imagine” SS Sink from “Hindware”/ “Nirali” / “Parryware”/, or “Hafele” with sample and brand approved by the E.I.C. prior to the procurement by the Contractor.

2.0 SOIL & WASTE PIPE & fittings:

All soil pipes shall be of Spun pipe of standard make. The thickness and specification shall conform to Indian Standard specifications IS: 3989-1984.

Pipes and fittings shall be true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand-hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with (3mm) rubber insertion packing and when closed and bolted, these shall be water tight.

Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.

M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Floor traps shall be of approved make, ‘P’ type with minimum of 2” (50mm) water seal. At the top of each of these Floor Traps there shall be provided with 5” dia. (125mm) CP brass circular Grating of approved make.

Approval of Sample of specified brand / make shall be done by the E.I.C. prior to procurement by the Contractor. E.I.C. at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

2.1 Lead Caulked Joints:

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm.(1“) from the lip of the socket for lead. the joint may be leaded by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring.

Before caulking, the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg (2 to 3 pounds) in weight in such a manner so as to make the joint sound. After being well set, the joint is to be flush, neat and even the sockets. The specifications etc., shall comply to the relevant IS & West Bengal P.W.D. specifications.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as given below (as a guide-line):
LEAD FOR DIFFERENT SIZES OF PIPES

<table>
<thead>
<tr>
<th>Nominal Size of Pipe (mm)</th>
<th>Lead/Joint (Kg.)</th>
<th>Depth of lead Joint (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>1.8</td>
<td>45</td>
</tr>
<tr>
<td>100</td>
<td>2.2</td>
<td>45</td>
</tr>
<tr>
<td>125</td>
<td>2.6</td>
<td>45</td>
</tr>
<tr>
<td>150</td>
<td>3.4</td>
<td>50</td>
</tr>
<tr>
<td>200</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>6.1</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>7.2</td>
<td>55</td>
</tr>
<tr>
<td>350</td>
<td>8.4</td>
<td>55</td>
</tr>
<tr>
<td>400</td>
<td>9.5</td>
<td>55</td>
</tr>
<tr>
<td>450</td>
<td>14.0</td>
<td>55</td>
</tr>
<tr>
<td>500</td>
<td>15.0</td>
<td>60</td>
</tr>
<tr>
<td>600</td>
<td>19.0</td>
<td>60</td>
</tr>
<tr>
<td>700</td>
<td>22.0</td>
<td>60</td>
</tr>
<tr>
<td>750</td>
<td>25.0</td>
<td>60</td>
</tr>
</tbody>
</table>

Note:

The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of the E.I.C.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as per relevant IS & West Bengal P.W.D. specifications.

2.2 Smoke Testing:

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. The Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the E.I.C. The test along with all equipments and accessories shall be carried out at the risk & cost of the Contractor at Site, in presence of E.I.C. or his representative complying to the relevant IS & West Bengal P.W.D. specifications.

2.3 Testing of Materials and works:

As and when required by the E.I.C. the Contractor shall arrange to test materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests, any materials, work or any portions of work are considered defective or unsound by the E.I.C., the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim
for this or for any rectification / modification shall be entertained by the E.I.C. All testing shall be guided by relevant IS & West Bengal P.W.D. specifications at the risk & cost of the Contractor.

3.0 G.I PIPES AND FITTINGS:

All pipes shall be of galvanized iron “Medium” quality (as per IS-1239, P-I) of “TATA” make unless otherwise specified or separately / specifically approved / allowed by NKDA. All fittings shall be of ‘HB’, ‘NB’, ‘Zoloto’, ‘Leader’, ‘JSI’ brand or other equivalent make bearing ISI certification mark. The pipes shall be seamless screwed of socketted conforming to the requirement of IS : 1239-1985. These shall be of the diameter (nominal bore) specified. The pipes and sockets shall be cleanly finished, well galvanized in and other defects. All screw threads shall be clean and well cut. the ends shall be cut cleanly and square with the axis of the tube. Sample tests for physical & chemical properties may be asked for by the E.I.C. at the risk & cost of the Contractor from Govt. laboratories / Test houses over & above submission of Manufacturer’s Test certificates.

4.0 (FULL WAY) GATE VALVES:

These shall be of Bronze / Gun metal (PN-10) or (PN-16) quality of “ZOLOTO”, “SANT” or ‘SBM’, ‘Leader’ conforming to the relevant IS specifications and tested to 21 kg. per sq. cm. for 2 minutes. Necessary Test certificates shall be submitted by the Contractor with warranty from the manufacturer as asked for by the E.I.C.

5.0 C.P. TOILET FITTINGS:

5.1 C.P. Brass Bib Cocks, Two-way Bib Taps, Stop cocks, Angle Stop cocks, Pillar cocks:

These shall be of Chromium plated Brass ‘heavy’ quality, threaded to BSPT (F) of ‘Marc’ / ‘Jaquar’, /‘Hardware’ / ‘Essco’ makes (as per the B.O.Q) conforming to IS specification as per IS- 8931. Sample approval shall be taken by the Contractor from the E.I.C. prior to procurement in bulk quantities with samples well preserved at Site at the risk & cost of the Contractor.

5.2 C.P. Brass Pillar Cock -(with Control Box) : [for Wash Basins]

This shall be of ‘Marc’ / ‘Jaquar’, /‘Hardware’ / ‘Essco’ model with wall mounted Control Box below the Wash Basins, threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from the E.I.C. prior to procurement with samples well preserved at Site at the risk & cost of the Contractor.

5.3 Health Faucets:

This shall be of ‘Marc’ / ‘Jaquar’, “Allied” model, /“Hardware” to be fitted with the Two-way Bib Taps inside each W.C.s (except Driver’s Toil), threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from E.I.C. prior to procurement with samples well preserved at Site at the risk & cost of the Contractor.
6.0 **BALL FLOAT VALVE**:

The Ball Float valves shall be of Brass body of high pressure or of Pressure as specified. The Ball valve shall be of brass and the float of PVC of high pressure withstanding capacity. The minimum gauge of PVC Ball Float, the body of the ball valve shall be capable of withstanding a pressure of 200 lbs. per sq.m. (14 kg. per sq.m.). the ball valve shall conform to IS specification No. 3708-1962. Necessary test certificates with warranty shall be submitted from manufacturers by the Contractor to the E.I.C. when asked for.

7.0 **DOMESTIC WATER FEED PUMPS TO TOILETS/ KITCHEN /TERRACE TANK FROM RAIN HARVESTING TANK / UNDERGROUND DOMESTIC WATER TANK-AT BASEMENT**:

<table>
<thead>
<tr>
<th>(A) WATER FEED PUMP from Rain Harvesting tank to Gardening use &amp; Toilet Flushing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Supply, Carriage, Installation &amp; Commissioning)</strong></td>
</tr>
<tr>
<td>It shall be of Hydro-pneumatic type Pumps in a single Skid with (2-working + 1-standby) for transfer of water from Rain Harvested Water Tank to directly to individual Toilets for Flushing &amp; for Gardening Points etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the water quality required for Flushing &amp; Gardening use (as per IS-10500).</td>
</tr>
<tr>
<td>(Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with &quot;Auto&quot; Start / Stop 3nos. 'Indfoss' make Pressure switch with each sets of Pump and one set of Pressure Gauge connected with a Ball Valve of 15mm dia to the Delivery Header.</td>
</tr>
<tr>
<td>Pump of Maximum capacity – <strong>333.0 LPM</strong> (i.e., 20 cum/hr.) @ <strong>50.0 M</strong> head with maximum <strong>4.4 KW</strong> (Working), 6.6 KW (Total Connected) - Motor input, 3 phase integrally coupled Motor, including Pump Control Panel, 100 Ltrs. capacity Air charged Diaphragm Tank (Pressure Vessel), Mounting Base, Baseframe, Pressure Switches, Panel to Pump Cabling, etc, including all necessary accessories.</td>
</tr>
<tr>
<td>(To be located near the Rain Harvested Water Tank in a Pump room)</td>
</tr>
<tr>
<td>Make = &quot;GRUNDFOS&quot;, Model :- ‘MPC F 4 CR 10-6’, &quot;Willo&quot; / &quot;SAMLSON&quot;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(B) DRINKING &amp; HAND-WASH WATER FEED PUMP from u/g Domestic Water Reservoir to different Toilets Wash Basins &amp; Ablution Taps, Kitchen Sinks, Drinking Water Units.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Supply, Carriage, Installation &amp; Commissioning)</strong></td>
</tr>
<tr>
<td>It shall be of Hydro-pneumatic type Pumps in a single Skid with (3-working + 1-standby) for transfer of water from the U/G Domestic Water Reservoir to directly to individual Toilets &amp; Kitchen for Handwash &amp; Drinking use etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the water quality required Drinking use (as per IS-10500).</td>
</tr>
</tbody>
</table>
Pumps should be with C.I. Impeller, integrally coupled with 3–phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with "Auto" Start / Stop 3 nos. 'Indfoss' make Pressure switch with each sets of Pump and one set of Pressure Gauge connected with a Ball Valve of 15mm dia to the Delivery Header, also including with one 100 Ltrs. capacity Air charged Diaphragm tank.

Pump of Maximum capacity – 500.0 LPM (i.e., 30 cum/hr.) @ 50.0 M head with maximum 6.6 KW (Working), 8.8 KW (Total Connected) - Motor input, 3 phase integrally coupled Motor, including Pump Control Panel, 100 Ltrs. capacity Air charged Diaphragm Tank (Pressure Vessel), Mounting Base, Base frame, Pressure Switches, Panel to Pump Cabling, etc, including all necessary accessories.

(To be located inside the Pump room of near the near the Basement Domestic Water Reservoir)

Make = "GRUNDFOS", Model :- 'MPC F 4 CR 10-6', /"Willo" / "SAMLSON").

(Make- 'GRUNDFOS" / 'WILLO" / "SALMSON")

Necessary test certificates with “warranty” from manufacturers as asked for by the E.I.C. shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of E.I.C. or his representative.

Necessary test certificates with “warranty” from manufacturers as asked for by the E.I.C. shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of the E.I.C. or his representative.

(C) BASEMENT DE-WATERING PUMPS:

Basement "De-watering Pump" shall be of Vertical Pump integrally coupled with motor, with matching Motor Control Panel of Mono-set fully submersible Vertical mounting type reservoir pumps for transfer of logged water from Basement to the adjacent outside building Yard Gully Chamber / Storm water Manhole.

Pump should be with CI 'Mixed Flow' / 'Radial Flow' type Impellers, integrally coupled with submersible type 3 – phase 2900 RPM 415volts, AC motor capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, but excluding pump control panel.

Pump of capacity – approximate - 200.0 LPM @ 8.0 M to 10.0 M head with KW (HP) Motor input, 3 phase integrally coupled "Submersible" type Motor.

(To be located inside the BASEMENT)

[1-working + 1-Standby]

Make = MBH, /"SEHRA"- Polder Pump / "DARLING" / "JALRANI").
8.0 **GLOBE VALVE:**

Bronze / Gun-metal Globe valve, rising / non-rising Spindle type (IS-778), screwed in Bonnet, provision of repacking under pressure, Teflon Gland packing, Class-I, with 'OPEN' / 'SHUT' indicator and locking device, and also with C.I. Wheel of approved quality (screwed end).

(Make: Zoloto, code: 1033 / "Sant" / "SBM" / "Leader")

It shall be of Bronze body Globe Valve with C.I. Wheel, screwed-in Bonnet, rising Spindle, Lubricated Gland Packing, conforming to IS-778, class-I, Bronze Disc & Disc nut, Brass Stem, with Asbestos Gland packing, and valve of approved quality (screwed end- female threaded). Necessary test certificates with warranty from manufacturers as asked for by the E.I.C. shall be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of E.I.C. or his representative.

9.0 **PRESSURE REDUCING VALVE:** (At Inlet Main to every individual toilets and Kitchen / Canteen – except the Top floor)

It shall be of 50mm and 32mm nominal diameter of Rubber Diaphragm type Pressure Reducing Valve of Bronze Body / Bottom Cover & Lock-nut (as per IS 318 LTB 2), Spring loaded, screwed (female) end as per B.S.-21 class with reduced Set pressure range (Up-stream - to - Down-stream) of 3.5 Kg. / sq. cm. - to - 1.0 Kg. / sq. cm., with C.I. Camber & Bonnet, Seat Ring & Stem of S.S. (AISI 410), Bolt/nut & Tommy Bar of M.S., C.I. Spring Disc & Carbon Steel Spring, & EPDM Diaphragm, C.A.F. Gaskets (IS- 2712, Gr.-C), and the Valve with a Test Pressure (Hydraulic) of 35 Kg. / sq. cm & with S.S. Screw / bolts / washers etc., and also with Teflon Thread Seal etc., all complete.

(Make - ZOLOTO- Product Catalogue no.-1040)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

10.0 **NON-RETURN VALVE (N.R.V.):**

Bronze body "VERTICAL -LIFT" type Non-Return ("Check") valve with S.S. (AISI-410) body Seat Ring, two-piece design, S.S.(AISI-410) Disc, Screwed to BSPT-female (BS-21), with necessary 'Teflon' Thread Seal, including accessories.

(Make - ZOLOTO- Product Catalogue no.-1045 / Leader)

(At Submersible Raw water Supply Pump Discharge pipe at the U/G Reservoir).

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.
11.0 **GATE VALVE (BRONZE BODY):**

It shall be of 40mm nominal diameter of **Gate Valve** of Bronze Body, hand wheel operated, screwed (female) end as per B.S.-21 class with Non-Rising Spindle, Screwed in Bonnet, and Lubricated Gland packing, & with a provision of re-packing, Valve conforming to IS-778, Class-I, outer body with Bronze conforming to IS-318 LTB 2, Bonnet, Stuffing Box & Gland of Bronze/forged Brass conforming to IS-318 LTB 2 / or IS-6912 FLB, Brass Stem, Bronze or Brass Gland nut, with C.I. Hand wheel conforming to IS-210 Gr.- FG 200, & with S.S. Screw / bolts / washers etc., and Valve Test pressure of 1.0 M Pa, and also with Teflon Thread Seal etc., all complete.

*(Make - ZOLOTO- Product Catalogue no.-1035 / Leader)*

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

12.0 **NON-RETURN VALVE (N.R.V): C.I. BODY:**

*(At Hydro-pneumatic Pump Discharge pipe)*

| These should be of C.I. Body, Check valve, Horizontal “Lift” – type with PN – 10 rating, with M.S. “Slip-on” type matching Flanges, along with CAF gaskets and appropriate M.S. Bolts, nuts, plain round Washers etc, all complete |

*(Make: “Zoloto”, code-1067)*

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

13.0 **AIR-RELEASE VALVE: BRONZE/GUN METAL BODY:**

*(At Water Supply Line top to different Blocks & to Kitchen pipe Riser top)*

| It shall be of Bronze / Gun metal body “Parallel Slide” – “Blow-off” valve with BS-10 Table-H/E Flanged ends, sliding action Discs, spring loaded, rack-pinion arrangement., S.S Discs, Body Seat Ring of S.S., Granite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable ‘OPEN’ / ‘SHUT’ arragt. of approved quality (Flanged end) |

*(Make: “Zoloto”, code-1052)*

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C.. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

14.0 **“BLOW-OFF” VALVE: BRONZE / GUN METAL BODY:**

*(At Water Supply delivery Main Line Hydro-pneumatic system for blow-off due Extra pressure in Main back to the U/G treated tank)*

| It shall be of Bronze / Gun metal body “Parallel Slide” – “Blow-off” valve with BS-10 Table-H/E Flanged ends, sliding action Discs, spring loaded, rack-pinion arragt., S.S Discs, Body Seat Ring of S.S., Grahite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable ‘OPEN’ / ‘SHUT’ arragt. of approved quality (Flanged end) |

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Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by the E.I.C.. The functionality shall be tested at site in presence of E.I.C. or his representative at the risk & cost of the Contractor.

15.0 **DRAINAGE- STONE WARE PIPES :**

All pipes shall be of best salt glazed variety conforming to IS specification. The pipes shall be free from visible defects such as fire cracks or hair cracks. The glaze of the pipe shall be free from blisters. The pipes shall conform to **IS : 651-1965**.

16.0 **SANITARY INSTALLATION :**

Sample approved shall be done prior to bringing in bulk quantities at site by the Contractor.

16.1 **The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556 (Part II & VII), 1967.**

16.2 **Fixing:**

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with waterproofing compound and made leak proof.

16.3 **Flushing by PVC ‘Low Level’ Cistern : (manually)**

The flushing of W.C. pan shall be done by “Hind ware” / Parryware / Cera make, PVC ‘Low Level’ Cistern- manually operated. with push lever.

16.4 **Brackets : (for Wall mounted W.C.- fixing)**

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair‘ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the Engineer- in charge.

16.5 **Flush Pipe :**

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.
16.6 **Seat & Lid:**

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

17.0 **URINALS:**

The urinal basin shall be flat back of white vitreous China of specified size. It shall be fixed in position by using wooden plugs and screws at a height such that the outside bottom of Urinal Basin remains at 600 mm. from the finished floor level. The Urinal Basin shall be of “Flat-back-Large” type. Standard height of the Urinal Basins shall be as per the respective Manufacturer’s standard. At least 200mm is to be given for fixing the “Jaquar” Sensor Installation Box from the top of the urinal (where the CP Spreader inlet Hole). Each urinal shall have 32 mm. dia. CP Bottle Trap with connected CP Waste Pipes, CP Waste Couplings etc, (as per the drawings).

17.1 **Waste Pipes-concealed & Traps:**

Each concealed Waste pipes (in proper slope) from the Urinals shall have 32 mm. dia. Rigid PVC (ASTM D 1785, schdl.-40) and this shall be further connected to 40 mm. lead of PVC waste pipe conforming to ASTM D 1785, complete with G.I. unions, elbows, tees (equal or unequal) (as per IS-1879) of approved make as specified in the schedule of quantities, including wiped plumber joint complete with unions shall be terminated upto the mouth of respective extension pieces of the 100mm dia C.I. ‘P’ traps (below floor finish).

The main and distribution pipes fittings and clamps shall be of C.P brass unless otherwise specified in the schedule of quantities, distribution pipes shall feed the urinals with C.P. brass spreaders of approved make.

17.2 **Painting:**

In case of cast iron flushing cisterns, painting shall be done as specified in the Bill of quantity.

18.0 **KITCHEN SINK:**

The above item shall be of **Salem Stainless Steel Kitchen Sink** - (AISI-304, conforming to IS-13983), **Single Bowl**, built with superior steel, with **Bowl size not less than**- 560 x 410mm and with **Bowl depth of 205mm to 215mm**; and **total overall size - 1145 x 510mm**, or of **approved size, with or without provision of a Drain-board**, also including with 40mm Salem Stainless Steel Unique Waste Coupler and Coupler knob with C.I. / MS fixing Brackets, and C.P. screws/washers etc.

(Make - 'Hind ware' - / Parryware / Hefeke / Nirali)

18.1 **Fittings:**

Each Sink shall have single pillar tap (Sink Cock with swinging lever of “Jaquar”, model-Clarion). It’s a special tap for the type of the sink specified and other fittings as specified, of
‘Jaquar’/ ‘Essco’ make 40 mm C.P. brass waste (CP) . C.P. brass angle valve with inlet connection of C.P. brass chain and rubber plug.

18.2 Waste Connection:
Waste pipe shall be of 1 1/2” dia. (32 mm.) rigid P.V.C. (concealed) pipe of approved make (as per ASTM D 1785), complete with unions. This shall discharge into a Floor trap.

18.3 Fitting:
Sinks shall be provided with 1/2”(15 mm C.P. brass valve) mixing fitting of ‘Jaquar’, or ‘ESSCO’ make complete with swinging spout.

18.4 Waste Connection:
The waste pipe shall be of PVC 1 1/2” (32 mm.) dia. As per ASTM D 1785, discharging upto the Floor trap. The rates shall include the cost of all materials and labour involved in all the operations described above.

19.0 TOILET REQUISITES:
Approval of Sample of specified brand / make shall have to be done by the Contractor prior to procurement.

19.1 Mirror:
Mirrors shall be of 6.0 mm. thick plate glass ‘Saint Gobain’ or ‘Modi-guard’ or “Ashai” make or approved equivalent make. The glass shall be uniformly silver plated at the back. Silvering shall have a uniform protective coating of red lead paint. The mirror shall have Plastic moulded frame of approved quality and colour. The mirror and its 6mm thick hard backing shall be fixed on the wall face to wooden cleats with C.P. brass screws and washers.

Toilet paper holder shall be of Chromium plated as specified in the schedule of quantities of “Jaquar” – Continental or “ESSCO”.

19.2 CP Robe Hooks (with double/ single Forks):
Theses should be of CP Robe Hooks with double / or single forks, of “Hind ware” / “Jaquar”- Continental supported on anodized chromium plated Base, fixed with 40mm long screws, rawl plugs etc., all complete.

20.0 WATER CLOSETS:
Samples shall have to be got approval from E.I.C. prior to procurement at site by the Contractor.
20.1 European type water Closets (EWC) : “Floor mounted type”.
(Hind ware / Parryware)

The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556 (Part II & VII), 1967.

20.2 Fixing:

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leak proof.

21.0 FLUSHING BY PVC FLUSHING CISTERN : (MANUALLY)

21.1 Brackets : (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair’ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the E.I.C.

21.2 Flush Pipe :

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.

21.3 Seat & Lid :

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

The W.C. Pans shall be of white Vitreous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of vitreous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556.

21.4 Fixing:

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the
concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leak proof.

21.5 Flushing by Flush valve: (manually)

The flushing of W.C. pan shall be done by “Jaquar” make, CP Flush valve with 32mm dia CP Control cock (Wall mounted), with push lever.

21.6 Brackets: (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair’ Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanized fixing Bolts, Nuts, and Washers etc, to the satisfaction of the E.I.C.

21.7 Flush Pipe:

The outlet of flush pipe from the cistern shall be of 32 mm rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the ‘Wall hung’ W.C.’s, and that shall be connected with the W.C. pan by means of an approved type of joint.

21.8 Seat & Lid:

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard ‘Hind ware’ or ‘Parryware’ makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

22.0 RAIN WATER PIPES OF C.I. (IS-3989 OR IS-1729) & CI PIPE FITTINGS
(IS-3989 OR IS-1729):

All Rain water pipes shall be of spun pipe and shall conform to Indian Standard specifications IS:3989-1984.

Pipes and pipe Fittings shall be true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand-hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The Fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with(3mm) rubber insertion packing and when closed and bolted, these shall be water tight. Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.
M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Sample and brand / make approval shall be done by the E.I.C. prior to procurement in bulk quantities by the Contractor. E.I.C. at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

22.1 **Lead Caulked Joints for Rain water Pipes:**

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm. from the lip of the socket for lead. the joint may be leaded by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg in weight in such a manner as to make the joint quite sound. After being well set, the joint is to be flush, neat and even the sockets. The specifications etc, shall comply to the relevant IS & West Bengal P.W.D. specifications.

The approximate depth and weight of pig lead for various diameters of spun pipes and specials shall be as given below (as a guide-line):

<table>
<thead>
<tr>
<th>Nominal Size of Pipe (mm)</th>
<th>Lead/Joint (Kg.)</th>
<th>Depth of lead Joint (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>1.8</td>
<td>45</td>
</tr>
<tr>
<td>100</td>
<td>2.2</td>
<td>45</td>
</tr>
<tr>
<td>125</td>
<td>2.6</td>
<td>45</td>
</tr>
<tr>
<td>150</td>
<td>3.4</td>
<td>50</td>
</tr>
<tr>
<td>200</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>6.1</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>7.2</td>
<td>55</td>
</tr>
<tr>
<td>350</td>
<td>8.4</td>
<td>55</td>
</tr>
<tr>
<td>400</td>
<td>9.5</td>
<td>55</td>
</tr>
<tr>
<td>450</td>
<td>14.0</td>
<td>55</td>
</tr>
<tr>
<td>500</td>
<td>15.0</td>
<td>60</td>
</tr>
<tr>
<td>600</td>
<td>19.0</td>
<td>60</td>
</tr>
<tr>
<td>700</td>
<td>22.0</td>
<td>60</td>
</tr>
<tr>
<td>750</td>
<td>25.0</td>
<td>60</td>
</tr>
</tbody>
</table>

Note:

The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of E.I.C.
The approximate depth and weight of pig lead for various diameters of spun pipes and specials shall be as per relevant IS & West Bengal P.W.D. specifications.

22.2 **Smoke Testing of Rain Pipes:**

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. The Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the NKDA. The test along with all equipments and accessories shall be carried out at the risk & cost of the Contractor at Site, in presence of NKDA complying to the relevant IS & West Bengal P.W.D. specifications.

22.3 **Testing of Materials and works:**

As and when required by the E.I.C., the Contractor shall arrange to test materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests, any materials, work or any portions of work are considered defective or unsound by the E.I.C., the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim for this or for any rectification / modification shall be entertained by E.I.C. All testing shall be guided by relevant IS & West Bengal P.W.D. specifications at the risk & cost of the Contractor.

All Rain Water pipes and fittings shall be spun pipes, conforming to the latest Indian standard specifications for Rain pipes. The pipes shall have spigot and socket ends, with bead on spigot and shall be with ears. Instead MS Holder Bat Clamps may be used for proper clamping on the wall.

These shall be free from cracks and other flaws. The interior of pipes and fittings shall be clean and smooth and the Pipes & Fittings are to be painted outside with Paints matching with the colour of the building outside wall paints.

The access door fittings shall be of proper locations and in no circumstances less than as shown in the drawings. Doors shall be provided with 3 mm. rubber insertion packing and when closed and bolted they shall be fully water tight.

22.4 **Joints of Pipes & Fittings:**

The annular space between the socket and spigot will be **Lead jointed by caulking tools** between the pipes & Pipe Fittings. This shall be done with 100% Leak-proof under Hydro-static Pressure **Test under 4.0 Kg-f / cm² (g)** pressure with a minimum Holding time of 1.0 hour and those joints after found tested OK shall be preserved and care is to be taken in such a manner so that there should be no undue load / impact / hammerage on those tested joints so as to make the joint quite sound. After being well set, the joint is to be flushed, neat and even the sockets.

The Pipes shall be of “SWR” class.
22.5 C.I. Roof Outlets:
The traps shall be of self cleaning design provided with a minimum 50 mm Water seal at the Trap to arrest Foul smell there stopping it to enter into the building inside from the respective Stacks. Further more every Floor Trap will associated with a S.S. “Chilly” make cockroach arrestor trap with SS Circular Grating.

23.0 Waste Connections:
Waste from Wash Basins, floor traps, Sinks, Ablution Traps inside wcs etc, shall separately discharged into the Waste Stacks that terminated & fed to the Gully Traps on the building outside ground level / Plinth protection level and shall be separately connected to (IP) Inspection Pits that leads to the Septic tank.

24.0 Anti-Syphonage (Vent) Pipes: 50mm dia C.I (sand cast as per IS-1729)
Anti-syphonage Vent pipe shall be HCl pipes of sand cast (as per IS-1729) with lead caulked joints and to be remained connected at a point with the Sewer Stack above every Junction Branches (keeping a gap of at least 450mm above the top-most Junction Branches per floor from the Stack and finally that 50mm dia Vent Stack after running parallel with Sewer Stack joined again with the Sewer Stack by 100 x 100x 50 mm dia Inverted unequal junction (IS-1729) above the top most finish floor level at a point above all the other horizontal junction points.

In every floor with the main anti-syphonage pipe junction Tees shall be 50 mm. internal diameter or as specified.

25.0 Painting:
All the exposed Spun Stacks / Pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of primer of approved quality, manufacture, colour and shade to match the surroundings. The cost of such painting should be included in the Contractor’s rates for pipe work.

The surface of pipes and fittings to be painted shall be cleaned thoroughly, Red lead or other primer shall be painted as specified and allowed to dry. the finishing shall be done by painting 2 or more coats with paint in an approved colour and shade.

26.0 WATER SUPPLY:
Sample and brand / make shall be got approved by the E.I.C. prior to bringing at site by the Contractor. Necessary test certificates shall have to be submitted from the manufacturer. Over & above the submission of test certificates, E.I.C. may ask the Contractor for further test from Govt. test house / laboratories at the risk & cost of the Contractor.

26.1 G.I. Pipes and Fittings:
The pipes shall be of galvanised steel, ERW, (IS-1239, P-I) ‘Medium’, screwed and socketed and shall conform to latest Indian Standard specifications for medium quality.
The pipes shall be tested to a pressure of 50 kg/sqm. these shall have threads and the sockets, paralleled threads complying to the relevant IS & West Bengal P.W.D. specifications.

26.2 **Laying & Fixing:**

Where pipes have to be cut or re-threaded, ends shall be care-fully filled out so that no obstruction to bore is offered.

In jointing the pipes, the inside of the sockets and the screwed end of the pipe shall rubbed over with white lead and few turns of hemp yarn wrapped round the screwed end of the pipe which shall then be screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing.

26.3 **Internal Work:**

For internal work, G.I pipes and fittings inside and outside the walls shall be fixed either visible (not in chase) by means of standard pattern holder bat clamps keeping the pipe 12 mm clear of the wall every where or concealed as specified in Bill of Quantity. When it is imperative to fix the pipe front of house or in any conspicuous position where it looks unsightly chasing may be adopted.

All pipes and fittings shall be fixed truly vertical and horizontal or as directed by the E.I.C.

26.4 **External Work:**

For external work G.I pipes and fittings shall be laid in trenches. the width of the trench shall be the minimum width required for working the pipes laid underground level. they shall not be less than 60 CMS from the ground level, and wrapped with gunny cloth dipped in hot bitumen. The work of excavation and refilling shall be done in accordance with the instruction of the E.I.C.

26.5 **Painting:**

All internal G.I pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of red lead primer of approved quality manufacture, colour and shade as directed by the E.I.C. The cost of such painting shall be included in the Contractor’s rates.

26.6 **Testing:**

All G.I pipes and fittings shall be tested to a pressure of 7 kg. per sqm. as specified in the relevant IS & West Bengal P.W.D. specifications to ensure that pipes have proper threads and that proper materials (such as white lead and hemp) have been in jointing. All leaky joints must be made leak-proof by tightening at Contractor’s expense. E.I.C. may ask the Contractor to submit the necessary test certificates in this regard.
27.0 **BRASS WATER FITTINGS**:

All water fittings shall be of standard manufacture as approved by the E.I.C. and shall be in all respects comply with the latest Indian Standard Specifications. The brass fittings shall be fixed in the pipe line in a workmanship like manner. Care shall be taken to see that joints between fittings and pipes are made leak proof. The fittings and joints shall be tested to pressure of 21 kg per sqm. unless otherwise specified. The defective fittings and the joints shall be repaired or replaced.

28.0 **SPECIFICATION OF WATER SUPPLY MATERIALS**

(As per Specifications Pages attached Annexure as a guideline to the Contractor)

**General:**

a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specification.

b) A set of specification samples of all approved materials shall be kept & well preserved at site by the Contractor for ready reference, cost of which is to be borne by the Contractor.

c) Over & above the list of specifications, NKDA reserves the right to ask the Contractor for fixing of materials / fittings of equivalent quality other than mentioned in the list.

29.0 **DRAINAGE**:

29.1 **Stone Ware Pipe**:

**Pipes**: All pipes must be new and perfectly sound, free from fire cracks and imperfection of glazing, cylindrical straight and of standard nominal diameter, length and depth of socket. They shall be hard burnt stoneware of dark grey colour and thoroughly salt glazed inside and outside. They should conform IS: 651-1980.

29.2 **Trenches for S.W. Pipe Drains**:

**Excavation**: The trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.

The gradient is to be set out by means of bending rods and should the required depth be exceeded at any point the trench shall be refilled by means of cement concrete of the specification of the bed concrete, at the Contractor’s own expense. The bed of the trench if in soft or made up earth shall be well watered and rammed and depressions thus formed filled with sand or other suitable materials as directed by WBSEDCL before laying the bed concrete.

If rock is met with, it shall be removed to 15 cms. below the level of the pipe and the trench will be refilled with concrete, sand or other suitable material as directed by WBSEDCL to bring it to
required bed level. the excavated materials shall be kept away from the edge of the trench at a
distance equal to 1 Metre or equal to half the depth of the trench which -ever is greater.

The trench shall be kept free from water. Shoring and timbering shall be provided wherever
required.

The trench width shall be the nominal diameter of the pipe plus 36 cms. but it shall not be less
than 52 cms. in case of all kinds of soils excluding rock and not less than 92 cms in case of rock.

Wherever the drain runs deeper , the width of the trench in the upper reaches may be
increased as per the directions of the E.I.C.

30.0 ROAD CROSSINGS:

All road crossings shall be excavated half at a time , the second half being commenced ,after
the pipes have been laid in the first half and the trench refilled. The trench at the existing road
crossings shall be filled in with mud concrete for the full depth except for the 15 cms layer
,which shall be filled with cement concrete 1:2: 4 or as directed.

31.0 PROTECTION OF EXISTING SERVICES:

All pipes , water mains , cables etc., met within the course of excavation shall be carefully
protected and supported. Such mains will be hung from timbers placed across the trench. Care
shall be taken not to disturb the electrical and communication cables, removal of which if
necessary may be arranged by E.I.C.

32.0 LIGHTING AND WATCH:

The open trenches shall be provided with requisite fencing and watchman to guard against
accidents. Red flags during day and red light during night shall be provided at the ends and at
intervals along the sides of the trenches.

Sign boards with necessary wording such as “SLOW, ROAD CLOSED” etc. shall be provided at
least 30 metres ahead of road crossing where the work is in progress. The precautions will be
continued till the surface is restored.
Temporary bridges or planks shall be provided over the trenches for keeping open the access
to private or public property.

33.0 REFILLING:

Refilling in trenches for pipes shall be commenced as soon as the joints and concrete have
been passed. The refilling on the top and around the drain shall be done with great care and in
such a manner as will obtain the greatest amount of compactness and solidity possible . For
this purpose the earth shall be laid in regular layers of 15 cms watered and rammed at each
layers. All surplus earth shall be disposed off as directed by the E.I.C.
CONCRETING:

All S.W. pipes shall be laid on a bed of 15 cms. thick cement concrete as specified with projection on each side of the pipe to the full width of the trench and surrounding the pipes all-round with 1:4:8 concrete mix.

All NP-3 RCC pipes below Road crossing / Car Parking areas shall be laid on a bed of 15 cms. thick cement concrete as specified with projection on each side of the pipe to the full width of the trench with 1:4:8 concrete mix.

The pipes with their crown level at 1.20 Metre depth and less from ground shall be covered with 15 Cms. thick concrete above the crown of the pipe and slipped off to give a minimum thickness of 15 Cms. around the pipe or as per construction drawing.

Pipes deeper than these shall be concreted up to haunches level with the top of the pipe.

LAYING AND JOINTING S.W. PIPES:

Laying:

The pipes shall be carefully laid to the levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc., from entering the pipes. The pipes between two manholes shall be laid in straight line without vertical or horizontal undulations.

The pipes will be laid "socket up" the gradient. The body of the pipe shall for its entire length rest on an even bed.

Jointing:

The cement mortar joints shall be cured at least for seven days.

Testing:

All joints shall be tested to a head of 60 Cms of water above the top of the highest pipe between two manholes.

The lowest end of the pipe shall be plugged watertight. Water shall then be filled in manhole at the upper end of the line. The depth of water in the manhole shall be 60 cms. plus the diameter of the pipe. The joints shall then be examined. Any joint found leaking or sweating shall be remade or embedded into 15 Cms. layer of cement concrete (1:2:4) in length and section re-tested, at the Contractor’s expense until satisfactory results are obtained.

GENERAL:

Under-ground Storm Water Drain Pipes:

NP-3 R.C.C. pipes are used for storm water drainage, on a concreting at pipe bed with 1:4:8 mix. The cement mortar for jointing with the Pipes and Collars will be 1:2 or that as specified in the Schedule of Quantities. Testing of joints also, will be
required under a Hydro-static Pressure Test under 1.5 Kg-f/cm² (g) pressure with
a minimum Holding time of 1.0 hour and those joints after found tested OK shall be tagged
"Tested OK" for those portion of the tested pipe and shall be preserved and
care is to be taken during back-filling in such a manner so that there should be no
undue load / impact / hammerrage on those tested joints so as to make the joint
quite sound.

36.2 **Precaution:**

To avoid logging of drains, both ends shall be kept plugged until the construction of manholes
is completed in every respect. On completion, care shall be taken that
each plug is removed and the face of the drain made smooth.

36.3 **Measurements:**

The measurements for providing, laying and jointing R.C.C. pipes shall be recorded
for the finished length of the pipe line i.e., from inside of one manhole to the inside of other
manhole.

37.0 **S.W. GULLY TRAPS :**

This must be new, perfectly sound free from fire cracks and other imperfections of glazing of
standard nominal diameter and other dimensions. It shall be made of hard burnt stoneware of
dark grey colour and thoroughly salt glazed inside and outside.

Each gully traps shall have a C.I. piping 15 x 15 Cms. and one water tight C.I. cover with frame
30 x 30 Cms. (inside dimensions) with machine seating faces or as specified.

37.1 **Excavation :**

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans
or as directed by the Engineer-in-Charge.

37.2 **Fixing :**

The gully trap shall be fixed on cement concrete foundation 70 Cms. square and not less than
10 Cms. thick.
The mix for the concrete will be 1 : 3 : 6 (1 Cement : 3 Sand : 6 Stone ballast) 40 mm gauge or
as specified. The jointing of gully outlet to the branch drain shall be done similar to jointing of
S.W. pipes.

37.3 **Masonry Chamber :**

After fixing and testing the gully and branch drain, a brick masonry Chamber 30 x 22.50 Cms
(inside in first class brick in cement mortar 1:5 shall be built with 11 Cms. thick around the gully
trap from the top of the bed concrete upto ground level. The space between the Chamber
walls and the trap being filled in with cement concrete of the specifications of bed concrete.
The upper portion of the Chamber i.e. above the top level of the trap shall be plastered inside
with cement mortar 1:3 (1 cement : 3 sand) finished with floating coat of neat cement. The
corners and bottom of the Chamber shall be rounded off so as to slope towards the grating.

37.4 **C.I. Cover:**

C.I. cover with frame 30 x 22.50 Cms. or as specified with mechanical seating faces shall then
be fixed on the top of the brick masonry with cement concrete 1 : 2 : 4 and rendered smooth.
The finished top of cover shall be left 15 Cms. above the adjoining ground level so as to exclude
the surface water from entering the gully trap.

38.0 **MANHOLES, INSPECTION PITS, GULLY CHAMBER ETC. :**

38.1 **Manholes:** (The size of Manholes) : The size specified shall be in the internal size of the
manhole. The work shall be done strictly as per drawings and specifications. The following
specifications shall be adopted.

38.2 **Excavation:** The manhole shall be excavated true to dimensions and levels, shown on the plan
or as directed by the E.I.C.

38.3 **Brick Work:** The brick work shall be with best quality brick in cement mortar 1:4, brick work
in arches shall be with 1st class brick in cement mortar 1:4, brick masonry round the pipes shall
also be with 1st class brick in cement mortar 1:4, the joints shall be made thoroughly leak
proof.

38.4 **Bed Concrete:** The manhole shall be built on a bed of 15 Cms. thick cement concrete (1 : 3 : 6
) over a layer of brick flat soling.

38.5 **Plaster:**

Inside of the walls be plastered with 12 mm. thick cement plaster 1:3 (1 cement : 3 coarse sand)
finished with a floating coat of neat cement.

In wet ground, 12 mm. thick cement plaster of the above specifications shall be done on the
outside surface of the walls also. This plaster shall be done with waterproofing admixture as
approved by the E.I.C. The plastering shall be done upto 30 cms. above the wet soil line. Extra
shall be paid for plastering the outside surface wherever directed.

38.6 **Pointing:**

Pointing shall be done with cement mortar 1:2.

38.7 **Benching:**

The channels and benching shall be done in cement concrete 1:2:4 and rendered smooth with
neat cement.

The following sizes of the channels shall be adopted for the benching :-
<table>
<thead>
<tr>
<th>Size of the Drain</th>
<th>Depth at the Centre</th>
<th>Depth at sides i.e., at walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm. (4&quot;)</td>
<td>15 Cms (6&quot;)</td>
<td>20 Cms</td>
</tr>
<tr>
<td>150 mm. (6&quot;)</td>
<td>20 Cms (8&quot;)</td>
<td>30 Cms</td>
</tr>
<tr>
<td>250 mm. (10&quot;)</td>
<td>30 Cms (11&quot;)</td>
<td>40 Cms</td>
</tr>
<tr>
<td>300 mm. (12&quot;)</td>
<td>35 Cms (14&quot;)</td>
<td>45 Cms</td>
</tr>
</tbody>
</table>

39.0 **R.C.C. WORK:**

R.C.C. work for slabs or lintels shall be in cement concrete 1:1 1/2:3 with steel reinforcement as per details. Plain concrete, if used for fixing manhole covers, shall be of (1:2:4) proportion, unless otherwise mentioned specifically in the BOQ/drawings etc.

40.0 **FOOT RESTS:**

These shall be of C.I. standard / or by M. S square rod 22 mm. or as specified and shall be galvanized or painted with coal tar. These shall be embedded in masonry in cement mortar at least 22.5 Cms. while the brick work is in progress. These shall be fixed 30 Cms. apart vertically and staggered laterally and shall not project more than 11 Cms., from the wall.

41.0 **C.I. MANHOLE COVERS:**

The C.I covers shall be of tough homogeneous cast iron of ‘heavy’ or ‘Medium’ type as specified in the Bill of quantities, are the clear internal dimensions. The approximate weights of the various types of manhole covers with frames and their internal size will be as per specification in schedule of quantities & conform to IS: 1726-1966. Variations in weight to the extent of 6 percent on either sides shall be permissible. The covers used in manhole on sewer lines shall invariably bear the work ‘SEWER’ on the top and those used for storm water drains shall bear the word ‘S.W.D.’. These markings shall be done during casting of the covers.

The frame of manhole cover shall be embedded firmly in the R.C.C slab or plain concrete as the case may be on the top of the masonry.

After the completion of the work, manhole covers shall be sealed by means of thick mortar greased. All exposed surfaces of the frames and covers shall be painted with coal tar. The cost of such paintings should be included in the Contractor’s rates for the manhole cover.

42.0 **PLAIN MANHOLE (TYPE A):**

As per drawing or 60 cms. x 45 cms. when not mentioned / shown specifically. This type of manhole is minimum generally constructed within compounds for house drainage only. Due to shallowness and narrowness the manhole is provided with cover with bigger opening to facilitate cleaning and repairs. Cover of size 90 Cms. x 45 Cms shall be used.
43.0 **PLAIN MANHOLE (TYPE B):**

As per drawing or 1.2 X 0.9 M when not mentioned / shown specifically. This type of manhole is constructed for main drainage work for depth less than 2.4 Meters.

When the manhole is built on the footpath ,this shall be provided with 45 Cms. internal diameter light type C.I cover , when it is built within the width of the road under traffic, it shall be provided with 53 Cms. internal diameter heavy type C.I cover.

44.0 **LEVELS OF INVERT OF INSPECTION PITS AND STORM WATER MANHOLES :**

All Invert levels as specified in the drawing to be maintained strictly as minimum requirement.

All Invert levels (I.L.) given in the drawings are with respect to the (+) 0.00 level as specified in the drawings.

Unless some acute problem as per the Site conditions the Invert levels as mentioned in the drawing shall have to be maintained.

For any alterations in Invert levels as per the Site conditions (if any) shall have to be approved by the E.I.C. before executing the job.

The invert of the smaller sewer at its junction with main shall be at least 2/3rd dia. of the main above the invert of the main . The branch sewer should deliver sewage in the manhole in the direction of main flow and the junction must be made with ease so that flow in the main is not impeded.

45.0 **MEASUREMENTS :**

The depth of the manhole wall be reckoned from the invert level of the channel to the top level as to the C.I cover . The depth shall be measured correct to nearest 25 mm.

46.0 **HOUSE CONNECTIONS :**

No drain from house fittings e.g. gully trap or soil pipe etc., to manhole shall exceed a length of 6 Meters unless it is unavoidable.

47.0 **DROP CONNECTIONS (DROP MANHOLES) – IF ANY :**

In case where branch pipe sewer enters the manholes on main pipe sewer at a higher level than the main sewer, a drop connection should be provided.

C.I. Inspection bend shall be fixed in position at right angle to the drop pipe at the level of the inlet branch drain. The plain C.I. shoe at the bottom shall be fixed in the benching cement concrete 1:2:4 (1 cement : 2 sand : 4 stone ballast ¾” size) so as to discharge into the channel (the joints be lead caulked as per specification for the cast iron pipes for water supply).
48.0 **C.I. PIPE DRAINAGE:**

48.1 **C.I. Drainage:**

C.I. pipe drainage shall be adopted (IS-3989 or IS-1729) in the case mentioned below:-

a) When the drain passes under a structure.

b) When the drain passes under a road which is subject to heavy traffic and where the covering cushion is not considered sufficient.

c) When the drain passes through a place where it is subjected to vibrations.

d) In hilly places where the slopes are very steep.

e) When drainage lines run on the surface or above ground.

48.2 **Trenches:**

Specifications for trenches for stoneware pipe drains will apply in this case.

48.3 **Pipes:**

The pipes used shall conform to the Indian Standard specifications for class “A” pipes.

48.4 **Fittings:**

C.I. trap with hopper, C.I inspection bends C.I. inspection Chambers etc., shall conform to Indian Standard specifications for C.I fittings.

48.5 **Laying:**

For laying C.I pipes and fittings, specifications for C.I water mains will apply.

The joints for pipes and fittings shall be lead caulked joints under water supply. The joints shall be leak proof.

All inspection doors etc., shall be provided with felt washers and strong brass bolts and nuts.

48.6 **Testing:**

Testing of joints for C.I pipes and fittings shall be done by smoke test as specified under C.I pipes and fittings.

48.7 **Masonry Chamber:**

C.I inspection chambers and bends for underground shall be enclosed in masonry chambers.

**NOTE:**
In case of non-availability of any particular brand of material as specified in the Bill of Quantities, bidder, Consultant or E.I.C may propose any other equivalent brand or material or equipment conforming to the latest I.S specifications. The approval of E.I.C in this regard will be final and binding.

**List Of Approved Specifications, Makes & Brands of Manufacturer for PHE work:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of Approved Material</th>
<th>Approved Brand / Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Water Supply:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>G.I. Pipes - medium class (As per 15-1239, P - I)</td>
<td>TATA/ Jindal / Utkarsh / Nezone.</td>
</tr>
<tr>
<td>2</td>
<td>G.I. Pipe fittings (as per IS-1239, P - II) ; of material with Galvanized Cast Iron Fillings, with material code conforming to IS-1879</td>
<td>HB’/ “NB’/ &quot;ZOLOTO&quot;/Leader / - &quot;JSI&quot; fittings ISI approved Heavy</td>
</tr>
<tr>
<td>3.0</td>
<td>C.P. on brass fittings</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>CP Bib cock</td>
<td>JAQUAR-Continental /ESSCO'-Delux' or 'sumthing special'/ “Marc”/ “Hindware” or as approved by ENGINEER-IN-CHARGE</td>
</tr>
<tr>
<td>3.3</td>
<td>CP Angle valve</td>
<td>- Do -</td>
</tr>
<tr>
<td>3.4</td>
<td>CP 'Concealed' Stop cock 'Heavy' type with adjustable CP wall Flange</td>
<td>- Do -</td>
</tr>
<tr>
<td>3.5</td>
<td>CP Shower Rose</td>
<td>- Do -</td>
</tr>
<tr>
<td>4</td>
<td>Gun metal body Ball Float valve with PVC (High pressure) Ball Float</td>
<td>Merck / Leader”/ “Sant” / “Neta</td>
</tr>
<tr>
<td>5</td>
<td>15 mm dia. PVC Connector pipe with Symet nuts at both ends. - (for Wash Basin Pillar tap &amp; W.C. &amp; Urinal -Cistern connections)</td>
<td>PRAYAG or as approved by ENGINEER-IN-CHARGE</td>
</tr>
<tr>
<td>6</td>
<td>Wall Outlet Connection Flexible Pipe - 15mm dia</td>
<td>“Jaquar” / “Essco”/ “Hindware”</td>
</tr>
<tr>
<td>7</td>
<td>Bronze / Gun metal-body Gate valve with threaded screwed ends, &quot;Non-rising Spindle&quot; type (PN-1.0) or (PN-1.6) class</td>
<td>Sant / “Leader” /“Merck”/ “Zoloto”-for Bronze body / “Neta” / SBM – “Peglar” type</td>
</tr>
<tr>
<td>8</td>
<td>Bronze -body Globe valve with ‘BSPT(F), threaded screwed ends, &quot;Non-rising Spindle&quot; type (PN-1.0) (PN-1.6) class</td>
<td>Valves of 'Zoloto', or ‘Sant’ or as approved by ENGINEER-IN-CHARGE.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Approved Brands / Specifications</td>
</tr>
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</tr>
<tr>
<td>9</td>
<td>CI body Gate / Sluice valve with flanged ends rising spindle&quot; type (PN-1.0) / or (PN-1.6) class</td>
<td>‘Sant’ / ‘Zoloto’ / ‘Leader’ / ‘Hawa’</td>
</tr>
<tr>
<td>11</td>
<td>CP Urinal Spreader-15mm (for Urinals only)</td>
<td>for all Toilets :- Hindware / &quot;Crabtree&quot; / &quot;Parryware&quot; or as approved by ENGINEER-IN-CHARGE.</td>
</tr>
<tr>
<td>12</td>
<td>Soil, waste &amp; vent pipes / and Pipe Fittings &amp; Specials :- C.I. Centri cast (as per 15-3989)</td>
<td>'NECO' / 'HEPCO' / 'KAPILANSH DHATU UDYOOG (P) LTD.' / &quot;BIC&quot;</td>
</tr>
<tr>
<td>13</td>
<td>Sanitary wares (Vitreous chinaware) :- W.C. - (European type) – with 'S' / 'P' - Trap - Floor mounted type, without PVC Flushing Cistern, ii) Wash Basins - &quot;Flat-back&quot; type rectangular pattern (size-550mm x 400mm) with “Essco” CP Pillar Tap / or “Swan neck” type Mixer, iii) Urinal - Flat back &quot;Small&quot; with CP Spreader, CP Waste coupling, CP Bottle Traps with waste pipes &amp; also with &quot;Jaquar' Sensors with installation box.</td>
<td>1st quality White Vitreous China-wares of ‘Hindware’ / 'Parryware' or 'Cera' :- for Vitreous chinaware W.C. :- Floor mounted &quot;Pedestal&quot; type- W.C. - of 'Hindware' - &quot;Popular&quot; without PVC Cistern but with PVC Seat &amp; Lid of 'Hindware', / 'Parryware' or 'Cera', CP Flush Pipe of approved standard make.</td>
</tr>
<tr>
<td></td>
<td>Wash Basin :- ‘Hindware’ - &quot;OVAL&quot; type or Parryware-equivalent / 'Cera’ equivalent Wash Basin Pillar tap equivalent as approved by ENGINEER-IN-CHARGE for Wash Basins.</td>
<td>For WC flushing :- PVC 'Low-level' &quot;Dual- Flush&quot; Cistern of 'Hindware&quot; &quot;SLEEK&quot; or equivalent Parryware or 'Cera’ Model. / or through “Jaquar” make CP Flush valve.</td>
</tr>
<tr>
<td></td>
<td>Urinals: - Hindware - &quot;Flat Back 'Large’- / or Parryware / or ‘Cera’ – equivalent.</td>
<td>&amp; for Urinals :- 'Jaquar', &quot;PRESSMATIC&quot;</td>
</tr>
<tr>
<td>14</td>
<td>Wall Mirror</td>
<td>6mm thick 'Modiguard' / 'Ashai' / or equivalent as approved by ENGINEER-IN-CHARGE.</td>
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<td></td>
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</tr>
<tr>
<td>15</td>
<td><strong>C.P. on brass fittings</strong></td>
<td>CHARGE, with 12mm thick hard-board backing</td>
</tr>
<tr>
<td>15.1</td>
<td>C.P. on brass fittings C.P. Waste Coupling, ii) C.P. Bottle Trap, iii) C.P Robe Hook, iv) C.P. Towel Rail. v) CP Two way Bib Tap</td>
<td>JAQUAR/ESSCO‘-Delux'/Marc /Hindware /or as approved by ENGINEER-IN-CHARGE</td>
</tr>
<tr>
<td>15.2</td>
<td>CP Toil. Paper Holder</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.3</td>
<td>CP Towel Ring</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.4</td>
<td>CP Soap Dish Holder</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.5</td>
<td>CP Bottle Trap with CP wall connection Pipe</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.6</td>
<td>CP Robe Hooks</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.7</td>
<td>CP &quot;Two-way&quot; Bib cock</td>
<td>- Do -</td>
</tr>
<tr>
<td>15.8</td>
<td>CP Shower Rose</td>
<td>- Do -</td>
</tr>
<tr>
<td>16</td>
<td>Rigid PVC (Concealed) Waste pipe, [Schdl.-40], (as per ASTM D 1785)- (concealed or exposed)</td>
<td>Supreme / Oriplast / Finolex/ Utkarsh</td>
</tr>
<tr>
<td>17</td>
<td>Rain Water Pipes :: C.I. – Sand cast &quot;SWR&quot; class, ' as per (IS: 1792)</td>
<td>NECO’/HEPCO’/KAPILANSH DHATU UDYOG (P) LTD./ “BIC”</td>
</tr>
<tr>
<td>18</td>
<td>Rain Water Pipe Fittings :: ‘Sand cast Iron‘ - &quot;SWR“ class, as per (IS: 1792)</td>
<td>DO</td>
</tr>
<tr>
<td>19</td>
<td>Salem Stainless Steel Sink as per AISI 304 (18/8 ) conforming to I.S.- 13983</td>
<td>“Hindware“ “Hafele“ ”Nirali‘, 'Parryware' / ”IMAGINE“ Brand from Saraswati Steel</td>
</tr>
<tr>
<td>20</td>
<td><strong>Stone- Ware Pipes</strong>, and S.W. Pipe Fittings</td>
<td>Sonali / GINNI / NIRALI / Hind</td>
</tr>
<tr>
<td>21</td>
<td>C. I. Manhole Cover ( I.S. - 1726) - &quot;Medium&quot; or &quot;Heavy&quot; Grade‘ (Light duty only on Oil/Grease Trap Chamber)</td>
<td>NECO’/HEPCO’/ Swastika // “BIC”.</td>
</tr>
<tr>
<td>22</td>
<td>NP-2 class R.C.C. Pipes and Pipe Fittings (i.e., RCC Collars etc.)</td>
<td>Eastern Spuncrete / ‘West Bengal Concrete Industries (P) Ltd. / ‘HINDUSTAN’ / ‘SUR’.</td>
</tr>
<tr>
<td>23</td>
<td>Stone- Ware Gully Trap</td>
<td>Sonali / GINNI / NIRALI / Hind</td>
</tr>
<tr>
<td>24</td>
<td>C. I. Grating- (Over Catch Pit / Yard Gully Chamber), ( I.S. - 1726) - &quot;Medium&quot; or “Heavy” Grade</td>
<td>NECO’/HEPCO’/ ‘BIC’/”Kapilansh Dhatu Udyog”</td>
</tr>
<tr>
<td>25</td>
<td><strong>STP- cum/day</strong> : As per the Detailed Specifications</td>
<td>“THERMAX” / “Ion-Exchange” / or equivalent.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Specifications</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>26</td>
<td>&quot;Enclosed&quot; Analogue type <strong>Water Meter (&quot;Bulk Type),</strong> conforming to IS- 2373 with Calibration Certificate, including all necessary accessories</td>
<td>&quot;Dashmesh&quot; / 'Kaycee&quot; / &quot;Capstan&quot;/ &quot;Kent&quot;.</td>
</tr>
<tr>
<td>27</td>
<td>Bronze body &quot;Parallel Slide&quot; &quot;Blow-off valve (&quot;Spring loaded, blow-off pressure sellable&quot; type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class</td>
<td>'Zoloto’ / Sant –make / Leader/ MERCK</td>
</tr>
<tr>
<td>28</td>
<td><strong>Air-Release Valve</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bronze body &quot;Parallel Slide&quot; &quot;Blow-off valve (&quot;Spring loaded, blow-off pressure sellable&quot; type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class</td>
<td>Zoloto’ / Sant –make / Leader / MERCK</td>
</tr>
<tr>
<td>29</td>
<td>Bronze / Gun metal -body Ball valve with 'BSPT(F), threaded screwed ends, &quot;quarter turn Lever operated&quot; type (PN-1) / or (PN-1.6) class</td>
<td>Valves of Bronze body : - 'Leader', 'Zoloto' – Metal only:- Sant make / Leader</td>
</tr>
<tr>
<td>30</td>
<td>Gaskets-CAF 'Full face' conforming to IS-2712, Gr.- C; (3mm thick)</td>
<td>&quot;Klinger&quot; / &quot;Permanite&quot; / &quot;Champion&quot;.</td>
</tr>
</tbody>
</table>

**Executive Engineer-I**

**New Town Kolkata Development Authority**