11.2

Technical specifications

HELVETAS
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Technical Specification

On

Project:

" Public Buildings Reconstruction in Jajarkot and Rukum West of Karnali Province"

Contract ID: SRP/CS/03/2024(RFP: SRP/02/2024)

Employer:

Skills and Reconstruction Project/Helvetas Nepal

Bakhundole, Lalitpur, Nepal

Country: Nepal

December, 2024

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100 GENERAL REQUIREMENTS

101 Bid Documents

The Specifications and Bills of Quantities shall be read in conjunction with the other Bid Documents. All the documents and drawings are to be regarded as mutually explanatory. In the event of any discrepancy or assumed discrepancy being found between them, the Contractor shall immediately inform the engineer of the matter in writing and the engineer shall issue his instructions in the matter in accordance with the Conditions of Contract.

102 Standards

All standards referred to in the Bid Documents or on any Contract Documents or Contract Drawings or instructions forming part of the Contract or issued under the provisions of the Contract shall refer to the editions in effect on the date of issue of the Tender Documents, or any superseding Standard, including all amendments published there to unless some other edition is specially referred to herein or referred to in instructions issued subsequent to the signing of the Contract.

The following references to standards shall be interpreted as follows:

BS	Standard by British Standards Institute
CP	Code of Practice by British Standards Institute
IS	Standard by Indian Standards Institute
ASTM	Standard by American Society for Testing and Materials
AASHTO	Standard by American Association of State Highway and Transportation Officials
NSM	Standard by Nepal Bureau of Standard and Meteorology
DUDBC	Department of Urban Development and Building Construction Specification
NBC	National Building Code of Nepal

Equivalent internationally recognized standards would be accepted as meeting the requirements of the specification subject to approval of the engineer.

Where it is unclear which specific provisions of a Standard are intended to apply, or where Standards may conflict in their requirements, the matter shall be referred to the engineer who shall make a determination, which shall not constitute a variation to the contract.

The Contractor shall maintain a complete set of Standards referred to in the specification, and those deemed equivalent, on site for review by the engineer. The Contractor shall also hand over one identical set of Standards to the engineer, and Helvetas Nepal.

103 Approval

The terms "approved", "directed", "instructed", "satisfactory", and "required' shall mean to the approval, direction, instruction, satisfaction or requirement of the engineer.

104 Location

Overall, nine different sites were investigated in different locations which are listed as below:

1. Aadharbhut Swasthya Sewa Kendra, Sanibheri-11, Aarma, Rukum West
2. Healthpost Kaina, Nalgad-3, Kaina, Jajarkot
3. Srijana Aadharbhut Bidhyalaya, Aathbiskot-14, Pipalchaur, Rukum West
4. Nepal Rastriya Aadharbhut Bidhyalaya, Bheri-9, Pouri, Jajarkot

105 Description of Works

The proposed work consists of construction of the RCC frame and load bearing structure building at the selected location, CSEB/ stone masonry works, door/window, plastering works, painting on inner walls,

floor/wall tile works, metal works, piping and sleeve works for electrical and sanitary works, landscape works and other associated works.

106 Restrictions on Contractor, Method of Work & Safety Procedures

The Contractor shall take account of the restrictions, method of work, sequence of work and other conditions detailed in the following sub-clauses of this clause.

106.1 Contractor's Responsibility

The Contractor shall be solely responsible for all the vehicles, equipment and personnel employed directly or indirectly and shall be responsible for ensuring that the requirements and restrictions imposed by this specification are understood and adhered to by all personnel engaged under this contract in the execution of the works.

106.2 General Safety

The Contractor shall be responsible for safety of all workmen and other persons entering the works and shall at his own expense; where not stated otherwise take all measures, subject to the engineer's approval, necessary to ensure their safety. Such measures shall include but not be limited to:

Provision of hard hat/ helmet for everyone entering the site with approved international color coding.

Provision of gloves, boots & safety belts as instructed by the engineer.

Provision of safety and emergency regulations for fire, gas, and electric shock prevention, together with rescue operation plan.

Provision of first aid room with in the construction site.

Safe control of flowing water.

Provision and maintenance of suitable lighting to provide adequate illumination at place of work with appropriate spares and standby unit

Provision and maintenance of safe and sound slings, pulleys, ropes, and other lifting device.

Provision of safe access to any part of the works.

Provision of safety net enveloping the facade of the building as instructed by the engineer. The material used in the safety net must be to the satisfaction of the engineer.

Provision of 26 Gauge (0.41 mm) CGI sheet for temporary protection of the site area with MS hollow pipes at the interval of 1.5 m c/c minimum.

Provision of notices in local dialect temporarily or permanently during construction at locations likely to be used by the public. Placement of such notices shall depend on the existence of the nature of work in the vicinity. These notices shall be in addition to any other statutory requirements demanded by the Contractor.

The Contractor shall submit a proposal with detailed safety and emergency measures for the engineer's approval. When the proposal has been approved, English and Nepali version of the regulations shall be made available to all of his Employees and the engineer.

The Contractor shall ensure that all his Employees are fully conversant with the regulations, emergency and rescue procedures etc. and shall enforce a rule that shall instantly dismiss any employee committing a serious breach of such regulations.

106.3 Liaison

For the purpose of complying with the requirements of this section of the specification and for exchanging information on the Works the Contractor shall designate a member of his staff to be called the Contractor's Liaison Officer who shall be solely responsible for the receipt of instructions from the engineer.

The Contractor's Liaison Officer shall be a senior member of the Contractor's supervisory staff and he shall have a good understanding of all the works carried out on the site. He shall be fluent both in Nepalese and English languages. The Contractor's Liaison Officer shall also be responsible for maintaining and posting an up to date list of telephone numbers of key personnel of the Client, the Consultant and the Contractor who should be contacted in the event of difficulties or emergencies while the Works are in progress.

106.4 Vehicle Movements

The Contractor shall control all construction related vehicle movements so as to avoid impeding traffic flows both within and outside of the site. Queuing of vehicles on road shall not be permitted. Vehicles shall be required to wait, if required, within the Contractor's compound/yard. The Contractor shall ensure that all vehicles he intends to use on the public roads comply with and are used in accordance with all relevant statutory regulations currently enforced in Nepal. The Contractor shall take every precaution and shall make adequate provisions to prevent excavated material or other debris being dropped or deposited on the public roads from his vehicles and shall promptly comply with any instructions issued by a local authority or by the engineer to remove at the Contractor's expense any material which is so deposited. Appropriate traffic signs shall be installed on the approval of the engineer for systematic flow of vehicle and pedestrians wherever necessary.

106.5 Security Barriers

The position and construction of temporary security barriers shall be subjected to approval of the engineer.

If the Contractor fails to reinstate such barriers as required, other forced arrangement may be made to do so with any resulting costs being recovered from the Contractor.

When it is necessary to remove or breach security barriers to gain access for construction, the Contractor shall supply a uniformed security guard to control access to authorized personnel and vehicles bearing suitable pass.

106.6 Marking of Work Areas

The Contractor shall be responsible for ensuring that work areas are adequately marked in accordance with the instructions of the engineer and that adequate temporary fencing, cones, flags, and temporary markings are available and used at all times. Work Area and Hazard Markers as shown by the drawing or as instructed by the engineer shall be used.

Before commencing work in any area the Contractor shall inform the engineer that he has completed the fencing and marking of the area. The Contractor shall not be permitted to commence work until approval has been given to the fencing and marking of such area. Once approval has been given the Contractor shall be responsible for ensuring that the fencing and markings remain intact and in the approved positions until all work is completed within that area.

After completion of the work in any area the Contractor shall not be permitted to remove any fencing or markings until the engineer have inspected the work and instructed the Contractor that they may be removed.

106.7 Brief Description of Construction and Sequence of Work and Constraints

The following clauses define the general sequence of construction for the Contract and describe the limitations on work in each area for operational reasons. The engineer may from time to time require variations to the work areas or place additional or lift some restrictions or limitations on the areas. The Contractor shall take account of such variations in his Bid and shall not be entitled to any additional payment in the event of such variations.

In accordance with the Conditions of Contract the Contractor shall submit a detailed program showing the order in which individual sections of the work are to be constructed and in doing shall take account of the constraints and restrictions described in this Section of the specifications and restrictions and limitations of the contract package and work area described below. The Contractor shall also examine the site and refer to the drawings for additional information on various constraints that may apply.

- **General**

The Contractor shall generally be allowed to work on site subject to security and safety conditions of clause 106
and only if the workforces are fully supervised. If the Contractor cannot demonstrate that the works shall be carried out in manner that is satisfactory to the engineer, further restriction shall be imposed to ensure the safety of the personnel on site and the Contractor shall not have any recourse to additional compensation.

- **Access to Work Area**

The Contractor may obtain access to the work at a point subject to the security, safety and coordination consideration of clause 106 of this specification. The Contractor's yard shall be located nearby the site on suitable area arranged by the Contractor. The yard should be away from obstacles limitation zone fixed by the engineer.

Access to the work yard may be done through existing access road. The Contractor shall construct temporary access road as and if required to haul the equipment and materials to work yard. No extra payments shall be claimed by the contractor for such temporary access.

- **Damage to Services**

The contractor shall be held liable for all damage to roads, shoulders, drainage, irrigation ditches, mains, pipes, electric cables, lines or services of any kind caused by him or his sub-contractors, if any, in the execution of the works.

The Contractor must make good or arrange to make good any damage at his own expense without delay and additional cost to the Employer and, if necessary carry out any further repair work ordered by the engineer. Any damage caused by the use shall be rectified / reinstated by similar materials as in existing construction.

- **Protection of Existing Facilities**

The Contractor shall protect all existing facilities, buildings, monuments and alike in the area of the works and shall not allow his personnel or sub-contractors or others within the work site to interfere with operation of these facilities.

- **Deliveries**

The deliveries, the Contractor's yard and work area should be in a manner to suit local ordinances and minimize disturbances to local population.

106.8 Contract Package

- **Scope**

The proposed Work consists of construction of the RCC frame structure building at the selected location, shear wall, brick masonry works, door/window, plastering works, painting on inner walls, floor/wall tile works, false ceiling works, metal works, piping and sleeve works for electrical, HVAC, communication, networking, firefighting and sanitary works, landscape works and other associated works.

- **Avoiding Disruption**

It is required that all these work be undertaken with minimal disruptions to traffic and daily activities of local people.

- **Methodology of works**

Construction works must be carried out in stages. Any work related to building must not start until the Contractor is fully prepared with construction materials in stockpile, installation, testing and commissioning of necessary plants and equipment; all requisite construction and other equipment are at site and in proper working condition; and approved safety and management measures are in place. Construction sequence shall be as shown on Drawing or as directed by the engineer in order to avoid

disruption in operation of movement and complete the work within the time as specified in Contract Data. Contractor should be prepared to work during night time also.

- **Temporary Relocations**

At various stages of work, existing utilities and functions may require to be temporarily relocated. The Contractor shall cooperate with the Employer and other affected to minimize disruption, find suitable relocation and provide temporary services and facilities, as required. All temporary relocations shall be approved by the engineer. The Contractor shall include temporary relocations in the Schedule (Critical Path Analysis) and Phasing Drawings submitted as a requirement of the Conditions of Contract and this Section of the specification.

- **Separation of Work Area**

At all times, work areas must be separated from Public, Consultant and Staff Areas by temporary hoardings. The Contractor shall be responsible for ensuring that consultant's areas remain free of dust, dirt, and debris arising from the construction and shall be responsible for any cleaning work thus to be executed immediately as directed by the engineer.

- **Weather Protection**

The work shall be protected from the effects of weather. Work shall be undertaken so as to avoid damage from wind and rain, or extremes of temperature or humidity.

- **Temporary Signage**

The Contractor shall be responsible for providing all temporary signage, to the engineer's approval, as required during construction. The Contractor shall erect temporary hoarding or secure fencing as he requires securing the construction areas in order to protect the public, which shall remain active at all times during construction.

- **Maintaining Services**

At all times, existing services must be protected and adequately maintained. This may require temporary measures, which shall be the responsibility of the Contractor subject to the engineer's approval. Temporary relocation of utilities, if any, shall be provided by the contractor at his own expense. Also, the Contractor shall ensure no disruption to the existing water supply, which also serves fire protection requirements. Programmed shut downs for re-connections shall be approved in advance by the engineer and shall be carried out in accordance with the approved schedule. Portions of the construction and relocation of all permanent and temporary lanes and access routes must be undertaken at night when the area is not busy.

107 Submittals

107.1 General Requirements

The Contractor shall maintain an approved system of recording and tracking submissions indicating dates, status (i.e. approved, not approved, approved subject to conditions), quantities, and other details as required. Copies of all approved submissions shall be retained securely and properly filed on site, available for reference by the engineer.

107.2 Program of Work

As soon as possible after the letter of acceptance and before signing of the Contract Agreement, the Contractor shall submit in triplicate the program and particulars required. In the program and particulars, the Contractor shall provide details of how he proposes to carry out the Works including:

a. A Critical Path analysis showing all major activities trades and phases of works. Detail shall be sufficient and to the satisfaction of the Employer to demonstrate the relationships and interdependencies between all aspects of the work. The Critical Path Analysis shall identify off-site as well as on-site activities including delivery lead times, shop drawing production and approval, materials testing, samples submission and preparation of mock-ups. The Critical Path Analysis shall be prepared by a competent and experienced construction programmer using a computer program approved by the Employer. It shall be prepared so as to permit revisions, inclusion of additional detail and regular updates as the work progress. The Critical Path Analysis shall include sufficient time for contingencies.

b. A detailed Statement of Construction Management Procedures the Contractor proposes to adopt shall be submitted. The Contractor shall also state his intentions regarding shift work. In all respects he shall pay particular attention to the security and operation of the site and seasonal rainfall and to the construction sequencing and restrictions identified for the Contract Package.

c. Detailed Phasing Drawings showing all the proposed phases and sequences of work, lines, types and details of hoardings and barriers, provisions to maintain public access and safety, temporary signage and all temporary work proposed shall be submitted by the Contractor to the satisfaction of the engineer. The scale of such drawings shall not be less than 1:500 for site works. As necessary to clarify the stages of work, independent drawings representative of each stage shall be prepared.

d. Once approved by the Employer the Critical Path Analysis, Statement of Construction Management and Phasing Drawings shall be incorporated into Item 2 of the Form of Agreement and shall be strictly adhered to unless any alterations are found to be necessary during the construction of the Works and are confirmed in writing by the engineer.

107.3 Contractor's Monthly Progress Report

The Contractor shall report monthly progress to the engineer on charts submitted in six copies and showing actual work done superimposed upon copies of the program. He shall furnish an explanation of any deviation from the program stating his proposals for improving progress should this be lacking in any respect and he shall furnish the engineer with his amended critical path analysis in triplicate.

107.4 Samples

The engineer may at his discretion request or take samples of any material or product intended for use in the Works. Where samples are requested in the specification they shall be submitted in the number requested or if not specified then as directed by the engineer. Samples shall be of the type and size specified and be fully representative of the materials proposed to be used. Samples shall be indelibly and clearly marked with the date of submission, material reference and any other data required to determine the source and kind of sample.

One or more samples of each kind submitted shall either be returned marked *"ACCEPTED"* and signed by a representative of the Employer or the Contractor shall be requested to provide new samples and be notified of deficiencies present in the submitted samples. One or more "accepted" samples shall be retained by the engineer for comparison with materials and workmanship supplied and shall form the standard of acceptance. One or more "accepted" samples shall be retained at the Contractor's site office and be available for reference on request.

The engineer may reject any materials and goods which in his opinion are inferior to the samples thereof previously approved and the Contractor shall promptly remove such materials and goods from the Site.

107.5 Copies of Orders

The Contractor shall provide the engineer with one copy each of all orders for the supply of materials and goods required in connection with the Works as the engineer may require.

107.6 Field Trials / Mock-Up

Field trials/mock-up of works (e.g. brickwork, stone pitching, plum concrete, steel structures, false ceiling) or specified shall be prepared by the Contractor for review and acceptance of the engineer. They shall be in a location agreed with the engineer, and if so specified may be incorporated into the work in a clearly identified position upon approval of the engineer. The Contractor shall carry out such changes or carry out field trials as required obtaining the engineer's approval. Approved field trials shall form the standard of acceptance of subsequent materials and workmanship.

107.7 Photographic Record of Existing Condition

A complete photographic record of existing site conditions shall be undertaken by the Contractor before commencing any work on site. The record shall include existing pavement, drainage, water supply and site areas affected by the work in sufficient detail to clearly portray all existing conditions of structures, finished, surfaces, fixtures and fittings. The Contractor shall submit three copies of 100 x 150 mm color

prints with digital copies for the engineer's approval. No work shall be undertaken prior to receiving approval from the engineer.

107.8 Photographic Progress Record

The Contractor shall provide a photographic and video graphic record of the execution of the works by having photographs taken at daily, if felt necessary, intervals from such points as the engineer may specify. The Contractor shall supply three copies of 100 x 150 mm color prints together with the digital copy of each photograph to the engineer within three days of the end of the month. Three sets of the aforementioned prints shall be captioned, and a typewritten label indicating the caption, date and signature of the Contractor and the engineer shall be affixed at the back of each photograph. One copy of such prints shall be returned to the Contractor.

107.9 As Built Drawings

The Contractor shall submit as Built Drawings in soft copy and print, within 30 (thirty) days of the issuance of the Letter of Completion. The following requirements shall apply for the same:

1. The drawings shall be prepared in CAD System.
2. The drawings shall include all available information on existing conditions as well as new construction.
3. Site drawings shall include as in the original drawings.
4. The drawings shall show the following:
    a. All site services existing, new and altered, including invert levels, sizes, capacities, manholes, lining and all other features.
    b. Detail log of groundwater exploration including tests performed, well development data.
    c. One original and three copies of drawings shall be submitted in bound sets sub-divided by discipline. Copy right of all material submitted shall be vested in the Employer without further compensation or charge.

108 Contract Drawings

The Contractor shall be issued with two copies of each of the Contract Drawings.

109 Construction Drawings and Shop Drawings

1. The Contractor shall prepare and submit construction drawings and shop drawings for details of construction work as and when instructed by the engineer.

2. The construction drawings shall show, at a suitable scale, all the particulars of the work including dimension, materials, finishes, lines, levels, tolerances and other details to show compliance with the specification, the suitability of item for its compliance.

3. The shop drawings shall show at a suitable scale all particulars of the work including sizes, capacities, performance, manufacturer, materials, methods of jointing, finishes, tolerance, site dimensions, lines, levels and all other details of work required to show compliance with the specifications, the suitability of the item for its purpose. Each shop drawing for non-catalogue items shall be prepared specifically for the project and shall include a title block indicating the project title, date of preparation, scale, item described by the drawings, fabricator's name, Contractor's name and a drawing number.

4. Brochures and/or standard drawings submitted for catalogue items of standard manufacture shall be clearly marked in green ink noting the relevant information and items to be supplied and the date of submission. The information supplied shall be equivalent in detail and content as that supplied for custom produced shop drawings.

5. The engineer shall review the drawings only for their general compliance with the intent of the drawings and specifications. Responsibility for accuracy of dimensions, technical design, performance and suitability for intended purpose of the items shall remain with the Contractor.

6. Three copies of each construction drawing and shop-drawing are to be submitted in sufficient time to allow for review, possible revisions and resubmission for approval prior to ordering materials, fabricating, installing and coordinating all affected and contingent work without delay to the schedule of construction.

7. The engineer shall retain two copies of all construction drawings and shop drawings. The remaining copy shall be returned to the Contractor signed by the engineer and marked "REVIEWED" with either:
   a. a request for resubmission and notes as to deficiencies;
   b. a note indicating the drawing has been reviewed but is subject to conditions noted or listed, and does not require resubmission; or
   c. a note indicating the drawing has been reviewed and is considered to meet the intent of the design and does not require resubmission.

8. The drawings shall be submitted at least seven days before the commencement of construction of work for which these drawings are intended.

9. Do not commence construction, fabrication, or order materials / products until sub-drawings or shop drawings have been reviewed and are returned under the Conditions of Contract except when / where instructed by the engineer.

110 Quality of Material and Labor

All materials incorporated in the Works shall be new, of the best quality of their respective kinds and entirely suitable for their intended purpose and conditions of services. The Workmanship in every case shall be of the best character and the whole shall be subject to the approval of the engineer.

111 Approval of Suppliers of Materials

Before entering into any Sub-contract for the supply of any materials or goods the Contractor shall obtain the engineer's approval in writing of the Sub-contractor from whom he proposes to obtain such materials or goods. Should the engineer at any time be dissatisfied with such materials or goods or with the methods of operations carried out at such Sub-contractor's works or place of business, he shall be empowered to cancel his previously given approval of such Sub-contractor and to specify any other supplier and the Contractor shall bear any additional cost thereof.

112 Removal of Condemned Materials

The engineer may request the Contractor to remove and dispose of any materials employed or to be employed in the construction of the Works which in the opinion of the engineer, are unsuitable or have been incorrectly deposited or have suffered damage by exposure to the weather or otherwise are not in accordance with the specified requirements for such materials. The Contractor shall be entitled to no payment, whatsoever, in respect of the removal of such materials.

113 Demolitions and Removals

Demolitions and removal work noted on or inferred from the Drawings and/or specifications shall be undertaken with care. Items identified by the engineer for hand over to the Employer, or identified for relocation, shall be removed with particular care and stored so as to avoid damage. All materials otherwise removed shall become property of the Contractor and shall be removed from the site forthwith. Items demolished or removed may not be reincorporated into the work except as indicated on the Drawings or when expressly approved or instructed by the engineer.

All existing work to remain shall be protected from damage. Any work affecting the structure of elements to remain shall not be undertaken without the engineer's approval. Proper care shall be taken to prevent disruption of and damage to services.

Methods of demolition shall be approved by the engineer, and shall generally take the form of dismantling unit by unit. Demolition by heavy machinery or explosive charge shall not be permitted.

114 Disposal of Excavated Materials and Waste

The Contractor shall not dispose on the site premises any excavated materials and/or spoils of any type obtained from the Site except in designated areas as determined and given in writing by the engineer. All other materials, in excess, shall be transported and disposed outside the site premises without causing any nuisance and inconvenience to outside publics at the cost of the Contractor.

115 Matching Existing

It is intended that, new work shall match existing in line, level, appearance, methods of construction, detail, material type, kind, quality, color, and in all other respects. Except to the degree that drawings and specifications indicate otherwise, the Contractor shall construct new work to match existing as closely as possible, where the kind, location, and function of the new work is similar. Where new work is unprecedented, the Contractor shall construct new work to the same principles to achieve a consistent appearance and required function.

116 Making Good Existing

Where work requires alteration to the existing work in any way, the Contractor shall be responsible for ensuring that the existing construction is made good. This shall mean that finishes, claddings, structures, services and all other elements are functionally restored and all work is made visually imperceptible and functional integral with existing work.

117 Setting Out

The Contractor shall set out the Works in accordance with the Drawings supplied by the engineer or as instructed in writing by the engineer. All levels shown on the Drawings are related to the points situated on the Site. Benchmarks (BMs) established during survey for design are related to these GPS points. The Contractor shall retrieve or reestablish these BMs by check surveys. The Contractor shall also establish additional benchmarks adjacent to the site. These benchmarks shall be referred to GPS points and reduced levels shall be transferred by first-order level survey. Refer also to the following Clause.

"Subject to the engineer's approval, make adjustments to setting out as required to meet lines and levels of the existing work." If, due to some constraints or reasons, the levels shown in the drawings or taken during joint survey are based on local datum the same shall be transferred to GPS.

118 Dimensions, Levels and Record Surveys

All dimensions and levels shown on the Drawings and referred to in the documents forming part of or issued under the Contract shall be verified by the Contractor on the Site, and he shall be held responsible for promptly pointing out errors or discrepancies in such dimension and levels. The Contractor shall be aware that building and civil work previously constructed and for which drawings may be provided or referred to, may have been completed by reference to obsolete datum.

The Contractor shall take and record levels in the manner directed by and in the presence of the engineer before the surface of any such area is interfered with or the works there on are begun. Such levels when approved and checked by the engineer shall be recorded on drawings which shall be signed by the Contractor and the engineer and shall form the basis of the measurements for the engineer's Certificates.

119 Testing

119.1 Materials Testing by Independent Laboratories

The Contractor shall be responsible for arranging for such testing to be carried out at an independent laboratory as approved by the engineer. The Contractor shall be responsible for all attendance on staff from these approved testing laboratories, including, if necessary, the provision of transport for personnel, equipment and test specimens. No testing by external laboratories shall be carried out without the written instruction of the engineer.

119.2 Quality Control Testing

Various clauses of the Specifications contained herein state the types of test, which the Contractor shall carry out for the control of the quality of Works, together with the frequencies at which each type of test shall be conducted. The Contractor's attention is drawn to the fact that the frequencies of testing specified in the relevant clauses are intended to represent only a general guide. The engineer shall be empowered to vary the frequencies at which tests are conducted should he deem this necessary for the proper control of the quality of Works. Should the engineer vary the frequency stated in the relevant clauses of the Specifications, the Contractor shall not be entitled to extra payment.

119.3 Tests Generally

The engineer may examine and may require to be tested any materials or goods required for the Works, such as he may decide from time to time. The Contractor shall arrange for the engineer and his Representatives to have unrestricted access to the Contractor's, Sub-contractors and supplier's premises for such purpose at all times.

The Contractor shall afford the engineer all facilities, assistance, labor and appliances necessary for the convenient examination, testing, weighing or analysis of all such materials or goods. The Contractor shall provide and prepare such test pieces of any such materials or goods as the engineer may require.

Notwithstanding any tests which may have been carried out off the engineer shall be empowered to order further tests of any materials or goods to be made on the Site and to reject any such materials or goods should they fail to pass such tests on site.

119.4 Test Certificate

Should the engineer not inspect any materials or goods at the place of manufacture the Contractor shall obtain Certificates of Test from the suppliers of such goods and shall send one copy of certificates to the engineer. Such certificates shall certify that the materials or goods concerned have been tested in accordance with the requirements of the Specifications contained in the Contract Documents and shall give the results of all the tests carried out. The Contractor shall provide adequate means of identifying the materials and goods delivered to the Site with the corresponding certificates.

120 On-Site Services for carrying out the Works

The Employer may help to make available the connection points for electricity and water for the execution of work at site. Supply may be interrupted from time-to-time in the event of technical problems and supply rationing. Distribution beyond designated connection points shall be the responsibility of the Contractor. The Contractor shall comply with any regulations laid down by the Employer (if, any) for use of electricity and water supply and shall pay charges as required. The Contractor should prefer to make his own arrangement for supply of electricity and water for execution of on-site work. Interruption in supply of electricity and water supply system shall not be the reason for claim by the Contractor.

121 On-Site Sanitary Services

Sanitary services shall be the responsibility of the Contractor. The Contractor shall provide suitable temporary toilet facilities for all persons employed in the execution of the Works in a location or locations approved by the engineer. Such facilities shall be cleaned twice daily. All sanitary waste shall be removed from the site at regular intervals and disposed off in a manner approved by the engineer.

122 Contractor's Yard

The Contractor shall make his own arrangement of area close by the site and/or within site, if given permission by the Client, to establish Contractor's Yard, for the exclusive use of the Contractor. The Contractor may erect such temporary buildings, or provide other facilities as required. The Contractor shall be responsible for providing an approved hoarding or other visual and security barrier at the perimeter of the designated compound as required providing security to the Contractor's facilities and safety to the public.

The Contractor shall make his own arrangements for 24 hours per day supply of electricity for power and light and of any other services required for servicing the Contractor's Yard. The Contractor shall make his own arrangements subject to approval by the engineer for the disposal of sewage and all waste materials during the execution of the Works. In the event of Contractor obtaining electricity through office supply system, the Contractor shall comply with any regulation laid down by the office for use of electricity from office system and shall pay charges, as required.

The Contractor shall make his own arrangements for providing adequate supplies of potable and other water. In the event of the Contractor obtaining water from office supply system or any other existing controlled supply, he shall comply with any regulations laid down by the office or other

agencies/organization (e.g.; Department of Water Supply and Sewerage, local communities managing the water supply system) and shall pay for charges as required.

All sources of water and the quantities of water withdrawn from them shall be approved by the engineer and shall be such that the requirements of the local population in respect of water for irrigation, drinking purposes etc, are not interfered with or prejudiced in any way.

The Contractor shall be responsible for removal of the compound facilities and structures, grading of the site and restoration of the site to at least the pre-construction condition of the site (as evidenced by photographs), which may also include planting of grass upon completion of the contract.

123 Environmental Protection

Spills or discharges of pollutants resulting from the Contractor's operations, or under his control, that may cause adverse environmental effects shall be immediately reported to the engineer. This shall include, but not be limited to all petroleum products and lubricants and any solvents or cleaning compounds.

The Contractor shall clean equipment in locations where debris and run-off shall be prevented from gaining access to storm water and drainage courses. Trucks hauling excavated or other loose material from the site on all roads other than those constructed solely as haul roads shall have loads trimmed before leaving the site in order that no spillage occurs. Any spillage shall immediately be removed to the engineer's satisfaction.

All surrounding private and public property shall be protected from damage during the works. Existing trees shall be preserved. Trees shall not be trimmed, damaged or removed unless previously authorized by the engineer. Soil compaction by traffic and root zone disturbance resulting from grade changes shall be prevented. Temporary erosion control, fences, and other protective measures shall be provided by the Contractor as required.

Adequate measures shall be provided to control dust at all times during the performance of the Work, and cover or wet down materials to prevent blowing dust and debris, to the engineer's satisfaction. Areas of blown dust or debris shall be cleaned promptly as directed by the engineer. During progress of the Work the Contractor shall provide and maintain to the engineer's satisfaction, control systems to prevent fine soil materials such as clays and fine silts eroded by surface run-off from entering any storm drainage system.

124 Damage to Services

The Contractor shall be held liable for all damage to roads, irrigation ditches, mains, pipes, electric cables, lines or services of any kind caused by him or his Sub-contractors, if any, in the execution of the Works. The Contractor must make good or arrange to make good any damage or provide temporary measures as instructed by the engineer at his own expense without delay and, if necessary carry out any further repair work ordered by the engineer.

125 Disposal of Waste

The Contractor shall make adequate arrangements to the satisfaction of the engineer for the disposal of all waste, storm run-off and sub-soil water, sewage and all other waste materials arising from or connected with the execution of the Works.

126 Complaints and Claims

During the course of the work, complaints and claims may arise from the public or from various authorities. The Contractor shall satisfy the engineer that he is dealing with all such matters without delay until appropriate clearance certificates from any authority concerned are produced by the Contractor. This Clause shall in no way absolve the Contractor from his obligations under Clauses specified in the Conditions of Contract.

127 Drainage during Construction

In addition to any other requirements mentioned in the Specifications the Contractor shall submit for the engineer's approval, prior to the commencement of construction of the Works or any Temporary Works,

detailed plans of the measures he proposes to take for the drainage during construction of the Works and Temporary Works, the checking out erosion of partially completed earthworks and pavements in the prevention of the movement of eroded materials and debris from construction areas into natural watercourses and on to adjoining land and stopping ponding during grading. In particular, the Contractor shall submit details of the methods he proposes to adopt for the drainage during construction of sub grades and partially completed pavements and of the measures he proposes to take to ensure that construction activities in no way affect the stability of existing slopes.

The Contractor shall carry out at his own expense all such approved measures and any additional measures the engineer may from time to time require improving their effectiveness. The Contractor shall take such measures as the engineer may require preventing the entry of spillage from concrete mixing operations, oils or other deleterious materials into any new or existing drainage system or natural water-course. Nevertheless, should any drainage system or watercourse be fouled by such materials the Contractor shall clean the drainage system or watercourse at his own expense to the satisfaction of the engineer. The operation of this clause shall in no way absolve the Contractor from any of his obligations under the Contract.

128 Weather Conditions

Without limiting his liabilities under the Contract, the Contractor shall make suitable arrangements to protect the Works, Temporary Works and Constructional Plant against the effects of weather. Unless otherwise specified all Works are to be carried out in the dry and they shall be kept free from water coming from any source whatsoever to the satisfaction of the engineer and at the Contractor's expense. All materials shall be stored on Site in a manner approved by the engineer and the Contractor shall carefully protect from the weather all work and materials which may be affected thereby.

129 Sources of Materials

For the purpose of the Contract, borrow and quarry areas shall mean and include all such areas approved by the engineer, which the Contractor may use to excavate or quarry materials for use in the Works. At the commencement of the Works, or as soon thereafter as is practicable, the Contractor shall submit to the engineer for approval details of the sources from which he proposes to obtain sand, gravel, rock aggregates, stone and filling for the Works; the periods during which he proposes to obtain materials from each of the several sources; the means and routes by which he proposes to obtain and transport these materials. No approval by the engineer of such proposals shall relieve the Contractor of his obligation to provide all the materials required for the Works, or any other obligation under the Contract.

130 Language

The Contractor shall make provision to the satisfaction of the engineer, technical assistants, foremen and leading hands to be both Nepali and English speaking.

131 Notice Boards

The Contractor shall provide and erect professionally prepared notice boards on the Site as directed. The minimum dimensions of the boards shall be 1.5 meters by 2 meters (min.). The wording, script materials and method of mounting shall be to the approval of the engineer.

132 Units of Measurement

The Symbols for units of measurement are used in these Specifications as they are given below.

M	micron = m x 10^{-6}
mm	millimeter
m	meter
km	kilometer
sq. mm. or mm^2	square millimeter
sq.m. or m^2	square meter
sq. km. or km^2	square kilometer
ha	hectare

cu.m. or m^3	cubic meter
lit or L	liter
rad	radian
°C	degrees Celsius
kg	kilogram
g	gram = kg $x10^{-3}$
mg	milligram = kg x 10^{-6}
mg/l	milligram per liter
t	ton = kg x 10^3
kg/m^3	kilogram per cubic meter
t/m^3	ton per cubic meter
N	Newton
N/m^2	Newton per square meter
Lin. m	Linear meter
Max	Maximum
Min	Minimum

Symbols of other units, if not covered above, shall be as per SI system set out in ISO 31/1.

133 Abbreviations

The following abbreviations are used in these Specifications.

ACV	Aggregate Crushing Value
BOQ	Bill of Quantities
CR	Crushing Ratio
CLPIU	Central Level Project Implementation Unit
dia	Diameter
DoR	Department of Roads
NEC	Nepal Engineering Council
DUDBC	Department of Urban Development and Building Construction
hr	Hour
HSPC	High Strength Portland Cement
LS	Linear Shrinkage
MC	Moisture Content
MDD	Maximum Dry Density
min	Minute
MoUD	Ministry of Urban Development
no	Number (units), as in 6 no.
No	Number (order) as in No 6
NRB	Nepal Rastra Bank
OMC	Optimum Moisture Content
OPC	Ordinary Portland Cement
PI	Plasticity Index
PL	Plastic Limit
PM	Plasticity Modulus (PI x % passing 0.425 mm sieve)
POL	Petrol, Oil & Lubricant
ROW	Right of Way
SE	Sand Equivalent
sec	Second
SG	Specific Gravity

SI	International Standard Units of Measurements
JIS	Japanese Industrial Standards
IS	Indian Standard
NS	Nepal Standard
SSS	Sodium Sulphate Soundness test, loss on 5 cycles
STV	Standard Tar Viscosity
TS	Tensile Strength
UC	Uniformity Coefficient
UCS	Unconfined Compressive Strength
VIM	Voids in Mix
w/c	Water cement ratio
wt	Weight
%	Percent

134 Scale of Drawings

Drawings must not be scaled for any purpose. Site information in particular may not be accurately reproduced to scale. Figured dimensions and levels on drawings and dimensions and levels determined from site measurement only should be used. Where there is inadequate information, and/or discrepancy with-in any information provided and/or discrepancy between information provided and site conditions, the matter must be referred to the engineer for instruction.

135 Works during the Defects Liability Period

After the commencement of the Defects Liability Period the Contractor shall do nothing that might endanger the safety of the general public or facilities and he shall obey all instructions of the engineer or any other duly authorized persons or authority by the engineer in this regard. Throughout the Defects Liability Period the Contractor shall notify the engineer of the work or operations he intends to carry out on the Site and he shall obey all instructions which the engineer may give as to times and manner to working so that any inconvenience is kept to a minimum.

136 Provisional Sums

Provisional sums are identified in the Bill of Quantities. For the use of provisional sum, the Contractor shall submit quotations or proposal of work/s as per employer's needs. Drawings or specifications for the items under provisional sum shall be provided or updated to the Contractor by the engineer upon approval of the Employer.

Expenditure of Provisional Sums shall be at the direction of the engineer upon approval of the engineer in accordance with the General Conditions of the Contract Agreement and shall not be specifically limited by the scope identified.

137 Assistance for Consultant & their Representative(s)

The Contractor shall provide at all times during the continuance of the Contract all such junior survey staff including chainmen, staff men and laborers for the exclusive use of Employer/Consultant as the engineer may deem to be necessary for carrying out his duties in connection with the Contract. The workmen shall be selected for their intelligence and so far as is possible the same staff shall be provided throughout the period of the Contract.

138 Facilities for Consultant

138.1 General

The Contractor shall provide, maintain and supply services to the offices, furnishings, equipment, laboratory and vehicles for the use of the consultant and their staffs as described herein. All facilities provided to consultant and his staff shall be new.

The full details of the facilities, which the Contractor proposes to provide for the consultant and his staff shall be submitted for the approval of the consultant's representative within 7 (seven) days of the start date.

The Contractor shall not complete any arrangements, or place orders for the hire/purchase of any items, nor start work on the provisions for the facilities for the consultant's representative until he receives approval from the consultant.

The Contractor shall complete the provision of facilities for the consultant's representative within 30 days of the Start date. During this period the Contractor shall provide such temporary facilities as may be required by the consultant's representative in the execution of their duties under the Contract. Alternatively, the consultant's representative and staff may make their own arrangement for temporary facilities in which case the Contractor shall reimburse the consultant's for the costs so incurred.

On completion of the Works in accordance with Conditions of Contract the consultant shall instruct the Contractor to remove those facilities not required during the Defects Liability Period. At the end of the Defects Liability Period the Contractor shall remove the remaining facilities from site in accordance with the Conditions of Contract. All furnishing, fittings and equipment provided for the use of the consultant and their staffs, except those items provided by the Contractor for the proper maintenance of the facilities of rented item, shall become the property of the Contractor at the end of the Contract.

138.2 Office for the Consultant's Representative

The Contractor shall provide a suitable office for the exclusive use of the Consultant's Representative and staff at convenient location near the site or within the site as approved by the engineer.

The Contractor shall provide electricity supply for 24 hours per day to all rooms. Power generators shall be provided with adequate stand-by to provide continuity of supply in the event of breakdown or maintenance.

Piped water for drinking use shall be supplied to the office together with sufficient tank storage to provide continuous running water for 24 hours. The contractor shall also provide any additional treatment or equipment (such as Euro guard electric filter) necessary for the provision of drinking water.

The Contractor shall be responsible for providing hygienic methods for the treatment and disposal of waterborne sewage, waste water and refuse from the office to be approved by Consultant's Representative.

The contractor shall be responsible for ensuring that the facilities provided for the office is secured. The contractor shall provide night watchman and take any other measure agreed with Consultant's Representative.

The maintenance of office building and all furnishing and equipment provided for the use of Consultant's Representative shall be the responsibility of the Contractor. He shall ensure that an adequate supply of replacement items and spare parts covering all the facilities is always available. He shall ensure that all the office rooms and yard, are cleaned every day and shall provide soap, towels, toilet tissue and all necessary cleaning material.

138.3 Minimum Support Staff of Contractor

The Contractor shall provide following support staff to assist in construction supervision unless stated otherwise in the contract on site.

Table 100.1: Minimum Support Staff of Contractor

S. No.	Position	Qualification	Total Work/Business Experience (years)	In Similar Work (years)	Remarks
1	Project Manager	Masters in Construction Management or Equivalent	Not less than 7 years	Not less than 5 years	Full Time

2	Civil Engineer	Bachelors in Civil Engineering or Equivalent	Not less than 5 years	Not less than 5 years	Full Time
3	Architect	Bachelors in Architecture or Equivalent	Not less than 5 years	Not less than 5 years	Full Time
4	Electrical Engineer	Bachelors in Electrical Engineering or Equivalent	Not less than 5 years	Not less than 3 years	Required During Electrical Works
5	Sanitary Engineer	Bachelors in Civil Engineering or Equivalent	Not less than 5 years	Not less than 3 years	Required During Sanitary Works

138.4 Minimum Equipment Required

Table 100.2: Minimum Equipment Requirement

S.N.	Equipment Type and Characteristics	Minimum Number Required	Owned/Leased/ Hired	Remarks
1.	Concrete mixer two bag capacity	2 (two)		
2.	Concrete mixer one bag capacity	1 (one)		
3.	Concrete pump(40m head)	2 (two)		
4.	Needle vibrator 1.9 HP, 12/2	5 (seven)		
5.	Plate vibrator 1.9 HP, 12/2	2 (three)		
6.	Hoist with capacity 1 Ton of appropriate height	1 (two)		
7.	Re-bar cutting machine	2 (two)		
8.	Re-bar bending machine	1(one)		
9.	A/C Generator, 50 KVA or more	1 (one)		
10.	Excavator (138 HP or more)	1 (two)		
11.	Tipper/Trucks	2 (seven)		
12.	Monkey Jumper	2 (two)		

139 Basis of Payment in General Requirements & Miscellaneous

Payment shall be made at Contract unit prices or in lump sum prices for each item in the General Requirements for which the Contractor shall be entitled to payment. These prices shall be full compensation for furnishing all materials and for all labour, equipment, tools, and incidentals necessary to complete the items. Where items are to be paid for by a Provisional Sum, terms of the Contract Agreement shall apply.

The Contractor shall be deemed to have included in other prices for any Clauses in the General Requirements for which there is no separate payment item stated below. Separate payment shall be made only for those items listed in the General Requirements and miscellaneous portion of the Bill of Quantities which include:

1. Laboratory Tests as ordered - Provisional Sum

Actual cost of laboratory test shall include for sample transportation from site to outside laboratory, testing charges and report.

140 Insurance

140.1 Insurance of Works and Contractor's Equipment

The Contractor shall take out Insurance for the Works and Contractor's Equipment from approved agency/institution staff if provided in the contract up to the completion of the project.

140.2 Insurance against loss or damage to Property in connection with Contract

The Contractor shall take out Insurance against loss or damage to Property in connection with Contract from approved agency/institution staff if provided in the contract up to the completion of the project.

Third Party Insurance

The Contractor shall take out Third Party Insurance from an approved agency/institution staff if provided in the contract up to the completion of the project.

140.3 Insurance of Employer's/Consultant's Engineer and Staff

The Contractor shall insure against such liability as stipulated in Particular Conditions up to the completion of the project.

140.4 Insurance of Contractor's Labor

The Contractor shall insure against such liability as stipulated in Particular Conditions up to the completion of the project.

141 Payment

Payments made to the agency/institution and stamp charges/duties incurred if any, by the contractor in compliance of the above work shall be paid for the item in the BOQ after submission of the insurance document to the satisfaction of the engineer.

200 GENERAL ARCHITECTURAL WORKS

201 Scope

201.1 Generally

a) This Division shall apply generally to all Part of Architectural Works and to other Sections/Divisions of the Specification containing Building Works items, unless otherwise stated.

b) The provisions herein are additional to, and are to be read in conjunction with relation to relevant sections of this specification.

c) Work under ARCHITECTURAL WORKS, consists of the execution and completion of all Architectural Works, as indicated on the Drawings or as instructed by the consultant.

d) The General Requirements are broad-scope and specify requirements in general terms only. The Contractor shall be responsible for all works necessary to provide work and operations as intended under and required by these specifications. Any items of Work which are not indicated on the Drawings or described in the Specifications but which are necessary to provide complete and operable Architectural Works shall be deemed to be included.

e) Associated Plant, materials and workmanship included in this Section, (such as concrete, reinforcement, metalwork, finishing, Electrical, etc) shall comply fully with the Specifications for other Divisions, unless otherwise particularly specified in this Section.

202 Submissions

202.1 Initial Submissions

a) Prior to commencement of work under each detailed Division of the Architectural Works, the Contractor shall prepare a detailed Method Statement describing the labour, materials and Contractor's Equipment to be used and the method of work execution and obtain the engineer's written approval. The Statement shall also describe the safety precautions to be adopted and all measures for compliance with environmental requirements and the preservation and protection of any structures, utilities or services which are to remain in place and operational.

b) The Method Statement is to be prepared separately for each detailed Part, for example for Part 200, 300, 400 etc. similarly for all other Architectural Works.

c) In addition, and prior to commencement of the particular Division of the Architectural Works, the Contractor shall prepare and submit the following (as further detailed herein) for the engineer's approval:

   i. Details of any equipment and material manufacturers and of any specialist subcontractor(s) including description of work experience, major equipment, labour, methods of quality control and safety control, etc.
   ii. Manufacturer's detailed technical data, specifications and installation instructions for all equipment and major materials and other components and accessories within this Section
   iii. Manufacturer's Certification for all equipment and major materials shall be provided by the Contractor (prior to installation) and indicating compliance with the requirements of the Specification. Where so instructed by the engineer, the Contractor shall obtain independent certification for materials, equipment and/or systems from independent and approved testing agencies, all at the expense of the Contractor.
   iv. Guarantee (see below)

d) Materials and equipment shall not be ordered or fabricated until the above submissions have been approved by the engineer.

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202.2 Further Submissions

Submissions shall be in accordance with Part 100 of the Specification, unless otherwise noted herein or in the Specifications for respective Divisions of the Works. The following submissions are required in addition to or in clarification of the requirements of Section 100:

(i) Equipment/Material lists;

A comprehensive schedule of the equipment and major materials shall be provided.

(ii) Shop and coordination drawings for all work required under this Section; Special attention shall be paid to the coordination of every Part with all other Sections and all the works listed in the bill of quantities of the Works including Civil, Electrical and Utility, and all other Part of Section 200 Architectural Works.

Shop Drawings shall clearly indicate the particular manufacturer's document number and fitting details used as reference in the development of the shop drawings.

Shop drawings shall be complete submissions for approval and, where applicable, shall include scale plans, and details of the equipment, structures, piping, cable and wiring and shall show the method of installation with all conduits, trays and other cable and pipe support and conveying systems and all foundations supports and accessories.

All Field dimensions shall be verified and included on shop drawings showing exact locations and dimensions.

(iii) Samples and test certificates of materials and equipment as specified or as requested by the engineer. Any materials delivered thereafter that the engineer considers not equal to the approved samples, shall be rejected and removed from the Site.

Samples should be the same as the permanent items to test the performance and show the workmanship, colour and finishes.

Samples are not returnable, nor included in quantities listed for the Works.

Approved samples shall be kept on Site for reference.

(iv) The following mock-up shall be constructed:

- One complete toilet room to demonstrate floor, wall and ceiling finishes, plumbing and lighting fixtures, plumbing accessories, toilet cubicle partition and door and all other relevant finishes and fittings.
- Internal and external signage assemblies
- One (1) check-in desk
- Internal and External walls
- Aluminum Door/Windows

(v) Comprehensive listing of all signs and nameplates required, giving full text for each item.

(vi) Certification of Installation shall be provided for all equipment and major materials (after installation) by the Manufacturer indicating that the completed work as constructed complies fully with the requirements of the Contract. Certification shall be complete with all necessary test reports, and data sheets.

(vii) As Built Drawings

(viii) Maintenance Instructions

(ix) The Contractor shall be responsible for obtaining from the manufacturer, for each type of fitting, control and accessory, the recommended operation and maintenance manual including tools required and types of cleaners to be used

(x) The Contractor shall incorporate the manufacturer's information within the Operation and Maintenance Manuals.

(xi) Operating and Maintenance Manuals

203 Qualifications

203.1 Generally

The equipment and materials shall be obtained from manufacturers who have been approved by the engineer.

203.2 Manufacturers

(a) To qualify for approval of their products, manufacturers shall:

- Have regularly produced the same or similar Plant, equipment and materials for more than 2 years prior to Tender opening;
- Possess necessary certificates and licenses for the manufacture and sale of required products;
- Take full responsibility for all requirements of the Plant, equipment, materials or systems where specified under respective Divisions of the Specification;
- Be capable of providing the Maintenance and Repair Services specified herein including the provision of emergency call out services within 4 hours, after notification by the engineer or the Employer;
- Be capable of entering into a full service maintenance agreement with the Employer after completion of the Defects Notification Period; and
- Directly employ well trained and experienced workmen and supervisors.

(b) The manufacturer shall fully substantiate all requirements hereof with sufficiently comprehensive and authentic documentation, in the English language for the review and approval of the engineer.

(c) The types of material and Plant proposed for approval shall have been in commercial service for at least three (3) years with satisfactory performance evidenced if so required by the engineer.

(d) In any one item of equipment or in any System, items and components shall generally be the product of one (1) manufacturer and units and parts thereof shall be readily interchangeable.

(e) Quality of products shall be of the highest international standard used for similar type of Project

203.3 Subcontractors

(a) To qualify for approval, subcontractors shall:

- Be a company which has regularly provided specialist installation work of similar equipment and systems as a main contractor or principal subcontractor for more than 5 years prior to Tender opening,
- Possess necessary certificates and licenses for the manufacture and sale of required products,
- Take full responsibility for all requirements of the equipment, materials or systems under respective Divisions of the Specification,
- Be capable of providing immediate call out emergency service within 4 hours either directly or through their locally authorized agent, after notification by the engineer or the Employer,
- Be capable of entering into a full service maintenance agreement with the Employer after completion of the Defects Notification Period,
- Directly employ well trained and experienced workmen and supervisors,
- Fully substantiate all requirements hereof with sufficiently comprehensive and authentic documentation, in the English language for the review and Approval of the engineer.

204 Applicable Standards

(a) All work shall be in accordance with Standards listed in Section 100.

(b) The International System of Units (SI) only shall be used.

(c) All plant materials and equipment shall be new, of good quality, and be approved by and bear the label of UL (Underwriter's Laboratory) or another independent safety testing laboratory acceptable to the engineer.

(d) Plant materials and equipment installed outdoors including protected areas (such as building soffits) and indoors in areas subject to water or extreme humidity shall be UL listed for damp locations.

205 Survey / Layout Requirements

(a) The Contractor shall prior to commencement of and during construction operations:

- Establish building column/grid reference system, and boundary or primary perimeter lines of buildings and various other structures included under this Contract.
- Establish utility entrance points at perimeters of buildings or other structures or areas, as applicable.
- Establish and control floor levels, and other structures; and finish grades for other areas within boundaries of work for this Contract.
- Establish reference points adjacent to Architectural Works areas sufficient for accurately locating utilities entering those areas and for laying out buildings and other structures within such areas.
- Coordinate and check all dimensions and levels, as work progresses, to ensure compliance with requirements.
- As work progresses, provide primary guide lines or points throughout each interior area as necessary to facilitate detailed layout of partitions, doors, windows, equipment foundations, ceilings and various other structures.
- Provide lines or marks on sub-floors as required, using paint or means sufficiently durable for the time required.
- Establish layout and location, as the work progresses, of every fixture, outlet of which details are not specifically shown in the Drawings or the Specifications but supply and installation are required under the Contract.
- Recheck and verify layout, locations and dimensions prior to making rough-ins or setting of other Work.

206 Coordination/ Correlation Requirements

206.1 Precautions

(a) Observe and comply with precautions and instructions of manufacturer when using any toxic, noxious or otherwise hazardous material.

(b) Use materials and perform operations as necessary to avoid fire damage or other injury or accident as required and dictated by good safety knowledge and judgment.

206.2 General

(a) Utility rough-ins, including required tests and other work to be covered up or concealed shall be completed and approved before such is enclosed or otherwise made inaccessible.

(b) Notify the engineer not less than fourteen (14) days in advance for each item of work being ready for testing or inspection.

(c) Rough-in work shall be approved by the engineer prior to being covered, concealed or otherwise made inaccessible.

(d) Power systems to be provided under any separate contracts shall be tested and approved prior to actual energizing of such power into electrical systems work required under this Section.

(e) Systems under this Contract shall be completed, tested and approved to ensure safety prior to utilization of said power sources.

206.3 In Advance of Work

a) Coordinate all work under this Section with layouts and all work in other Sections or Divisions and incorporate adjustment as and where necessary to ensure a properly coordinated installation and complete and operable Systems as intended as required by and intended under these Contract Documents.

b) Coordination includes, among others, considerations of locations, sizes, capacities and performance characteristics of equipment furnished and installed under other Sections and Divisions.

c) Coordination further includes providing adjustments in the electrical work to meet needs of said equipment and cooperation with other contractors or subcontractors as may be necessary to make the determination required.

d) Ensure that correct anchor and fixing systems are selected compatible with substrate types and conditions.

e) Provide layout, templates and or instruction as necessary for proper preparation of supporting construction.

f) Provide all necessary sleeves, inserts, bolts, backing plates or other incidentals embedded in concrete or masonry or attached to and/or concealed by work under other Sections and Divisions.

g) Furnish in quantities and deliver at times necessary for properly arranged and timely installation.

206.4 Drawings

a) Drawings shall be examined and developed as necessary to achieve fully coordinated and proper installations as intended herein.

b) Electrical, Sanitary and Terminal Equipment Works indicated in the Drawings are generally diagrammatic and location of openings, outlets, Plant, equipment, fixtures and fittings are approximately only.

c) Verify that sizes and locations are adequate and proper and develop as required.

d) Exact routings and locations including layouts and positions of Plant, equipment, pipes, cables, wires, trays, conduits, outlets, equipment and other items shall be coordinated by the Contractor with all civil, building, structural, electrical, sanitary and utility works in other Divisions to avoid conflict and to provide systematic and well organized Plant, equipment, pipe, cable/wire and related works installation.

e) Contractor designed routing and locations shall be coordinated in order to ensure easy maintenance and proper operation.

f) Arrange for additional facilities and openings for access or maintenance where and as may be required.

207 Material and Product Requirements

207.1 Generally

a) All Plant, materials and equipment for Architectural Works shall be designed, fabricated and constructed for purposes and uses intended and in accordance with or capable of meeting standards as specified herein.

b) Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise evidenced by such operational reports and data as may be required by the consultant to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.

207.2 Product Requirements

a) Unless otherwise shown, specified or approved, shall be Manufacturer's first quality line of standard and/or series of factory fabricated items.

b) Plant, Materials and equipment specified shall conform to JIS, IS, NS, or equivalent standards and where so directed by the engineer, shall be tested, in accordance with relevant standards by an approved independent agency and shall be certified as conforming to such requirements.

c) Comparable materials, assemblies and systems of manufacturers other than as specified may be proposed where the same or differing in minor details only and otherwise comply with requirements shown or specified, subject to prior approval by the engineer.

d) Materials and equipment shown or specified shall be essentially standard catalogue products of an approved manufacturer and any variations thereto shall be only as specified or approved by the engineer.

e) Where two (2) or more units of same class, type or kind are required, units shall be products of a single manufacturer.

f) Where a device or part of a piece of equipment is referred to in singular number, such reference shall apply to as many services or parts as are needed to complete work required.

g) Similar mechanical and similar electrical parts and components should be identified throughout each system and be readily interchangeable.

h) Mechanical System or principal components thereof of similar type shall be designed, fabricated and supplied by a single manufacturer for all work under this Contract.

i) Substitution of keyed locks not complying with specified requirements shall not be permitted.

j) Substantial increase in overall size(s) of items of equipment or major components shall not be permitted, unless approved in advance by the engineer.

208 Execution Requirements

208.1 Pre-requisite Conditions

a) Work shall not proceed until the Contractor has verified that supporting construction is in proper condition per requirements specified herein and any improper construction conditions have been corrected and re-inspected and that layouts, location and tolerances are correct for this work.

208.2 During Construction

a) Remove waste and debris as work progresses and on completion.

b) Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.

c) Touch-up abraded or damaged prime painting or galvanizing and leave clean and ready for finishing work required all to approval.

208.3 Supervision

a) Furnish the full-time services of one (1) or more Project Manager, as stated in 138.3, well qualified in directing and overseeing all phases of the various work all as approved by the engineer.

b) Furnish the services of manufacturer's representatives or other especially qualified persons as necessary to supervise installation of equipment, major or specialist materials, all ducts and pipe work all as instructed or approved by the engineer.

208.4 Protection

a) Protect work herein during construction and after completion.

b) Protect adjacent construction and finishes.

c) Repair or replace at the Contractor's expense and as directed by the engineer any works or any adjacent exposed surfaces stained or otherwise damaged resulting from use of materials or operations under the electrical work.

208.5 Operation before Final Acceptance

a) Should the Employer require that any portion of the Works or any Plant or equipment be operated for testing purpose prior to date of substantial completion and Taking Over, the Contractor shall consent and such operation shall be under supervision and direction of the Contractor. The operation so required prior to substantial completion shall not be construed as nor constitute acceptance of work so operated, nor construed contrary to requirements for early activation of systems.

208.6 Upon Completion

a) Exposed and concealed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.

b) Installation shall be free from exposed fastenings, unnecessary cuts, holes, blank plates or advertising labels or signs other than indicated, specified or approved.

c) Exterior or below grades installation watertight throughout and free from leaks or entry of water into a through interior or concealed spaces of the structure.

d) Each item, unit, or assembly shall be tightly and rigidly secured in place, free from unnecessary movement, squeaks or rattles.

e) Each item, unit assembly shall be set straight, plumb and level, accurately positioned at locations required and adjacent similar units accurately aligned.

f) Movable or mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and free from binding, superfluous or unwanted noises.

g) Electrical devices assemblies or systems shall be properly connected, grounded, and operating in compliance with the performance requirements and tested as specified.

208.7 Work not in Compliance

a) Repair or replace as directed by the engineer.

208.8 Equipment Identification Requirements

a) Exposed surfaces of fixtures, Plant and equipment shall be free from shop or factory applied manufacturer's/vendor's labels, advertising, insignia, emblems, decals or other like devices.

b) All items shall be otherwise identified in compliance with the requirements specified herein.

c) Manufacturer's identification labels are required for all factory fabricated fixtures, Plant and equipment. They shall be applied so as to be concealed when the item is installed and normally closed, but shall be readily visible and readable when opened.

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d) Each label shall be of standard manufacture, non-corrosive and durable and permanently affixed.

e) Labels or nameplate shall state fixture or equipment item type, model number, rating and current characteristics.

f) Product Identification Signs are required for each electrical equipment item, in readily visible locations, each sign installed level and accurately and symmetrical positioned. Sizes shall be suitable for equipment, colours shall be as instructed by the engineer and lettering shall be plain block or gothic style only

g) Circuit Directories are required for every panel containing electrical control or safety devices and directories shall be installed on the inside of all panel doors. Each directory shall be correlated with the panel in which it is installed and shall be in typewritten tabular form. Each directory shall be protected by a laminated plastic cover and secured to the door with a suitable metal frame all to the approval of the engineer.

208.9 Protective Coating/Painting

a) Unless otherwise specified or approved, ferrous materials used in Plant, equipment and materials shall be shop galvanized. Internal components shall generally be electro-galvanized, external components shall generally be hot dip galvanized.

b) Alternatively, Aluminum alloy may be used subject to obtaining the approval of the engineer.

c) Exposed surfaces of Plant, materials and equipment shall also be finish painted. Unless otherwise approved, finish painting shall be factory applied. Surfaces shall be cleaned, primed with two coats of rust inhibiting sprimer, finished with two (2) coats of enamel and baked (colour shall be selected by the engineer), in accordance with approved manufacturer's standard factory processes. The painting shall be done on contractor's expenses.

d) Special finishes shall be provided where shown or specified.

e) Unless otherwise specified or approved, site finish painting shall be as per BOQ or approved by the engineer.

f) Painting work and materials required herein and not otherwise specified shall be in accordance with applicable requirements specified.

208.10 Lubrication/Maintenance Requirements

a) Lubrication facilities shall be provided for all parts involving friction and wear other than where suitably covered or protected by resilient materials or where provided with life-time packing or fittings.

b) Provide all necessary facilities including grease fittings, oiling caps or other like facilities as required to maintain equipment properly protected and with all like items essentially identical and serviceable using same lubrication tools throughout.

c) Locate lubrication facilities where readily visible and position where easily accessible.

208.11 Safety Guards

(a) Required for all sheaves, couplings and other running equipment which could cause physical injury upon accidental or inadvertent contact.

208.12 Keyed Locks and Switches

a) Keyed locks shall be master-keyed with the master-key system of the Building Works.

b) Master-key system shall be in accordance with the requirements of the Specification or as approved by the engineer.

c) Exact requirements for keying shall be as directed by the engineer at a later date after commencement of the Works.

d) Keys shall be handed over to the Employer in accordance with the requirements or accepted by the engineer.

208.13 Cutting and Patching

a. Provide all necessary holes, accesses and supports wherever necessary and where prior arrangements therefore have not been otherwise provided.

b. Execute all cutting, provide all sleeves, frames, escutcheons and other accessories required.

c. Execute all repair, patching, cleaning, refinishing and other work as may be required and make good.

d. All work to be approved by the engineer.

209 Guarantee

a) Refer to respective Divisions of the Specification.

b) Any guarantees/warranties required by respective Divisions of the Specification shall be provided in writing and in a form approved by the engineer and Employer, for the due and faithful observance and performance of this obligation. Such guarantees/warranties shall be delivered to the engineer for approval at the same time as the Request for Approval (RFA) as specified in the relevant part of the Works, Plant, System, equipment, materials or manufacturer of the particular Division.

210 Testing

a) All Building Works shall be tested according to the requirements of the detailed Specification.

b) Tests shall be carried out as stated in the different sections of this specification.

c) Factory witness testing and inspection (attended by representatives of the consultant/employer), at the discretion of the engineer shall be required for other Plant or materials obtained from or manufactured in Nepal.

211 Related Requirements

211.1 Training of Office's Personnel

a) Training is required for all systems in accordance with the requirements of respective Section.

b) Minimum periods of training shall be in accordance with Table 211.1:

Table 211.1 – Training Requirements

Section/ Division	Description	Detail	Factory Visit	Site Training
	General	General training on maintenance cleaning and repair of all components and works including sanitary, electrical, system etc.	Required	1 week

c) Factory Training is not required unless proposed by the Contractor.

d) Requirements for training and the number of persons to be trained shall be as specified in the particular Divisions of this Section.

211.2 Tools/ Spare Parts

a) Provide tools as follows:

I. One (1) complete set of lubrication tools for each type of Plant, equipment and System,

II. One (1) complete set of maintenance tools of suitable types and adequate sizes,

III. One (1) Multi-tester for electrical systems,

IV. Any further particular tools and test equipment as specified in respective Divisions or which in the opinion of the engineer are required for proper service and maintenance of the System.

V. All tools shall be contained in a suitable and approved steel box.

211.3 Spare Parts shall be provided as instructed by the engineer.

211.4 Maintenance and Repair Services

a. The Contractor shall comply fully with the requirements of the Contract regarding rectification of defects during the Defects Notification Period.

b. In addition to the requirements of Conditions of Contract Clause, the Contractor (or his authorized and approved agent) shall attend within seven (7) days to repair or rectify any defects found to be arising during the Defects Notification Period as determined by the engineer.

212 Measurement/ Rates

212.1 General

Measurement/Rates for Architectural Works shall be in accordance with the detailed requirements included in the respective Divisions of the Specification.

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300 CLEARING, GRUBBING AND REMOVALS

301 Description

This item shall consist of clearing and grubbing all areas within the limits designated on the plans or as required by the engineer and removing all buildings and structures from the site as shown on Drawings or as directed by the engineer and as per Bill of Quantities. The work shall also include the disposal from the site, of all spoil materials resulting from clearing, grubbing and removals.

302 General

The areas denoted on the plans to be cleared and grubbed under this item shall be stacked on the ground by the engineer or and his staff. Clearing, grubbing and demolition shall be done sufficiently in advance of the earthworks and construction of permanent works in the designated area.

303 Disposal of Spoil

Spoil materials removed by clearing, grubbing and demolitions shall be disposed off by burning or by removal to approved disposal areas. Piles for burning shall be placed either in the cleared area near the center or in adjacent open spaces where no damage to trees, other vegetation, or other property will occur. The Contractor will be responsible for controlling fires and obtain the prior approval of the engineer before burning any piles of cleared materials so as to avoid interference or nuisance to aircraft operations. Ashes resulting from burning shall be removed and disposed to spoil areas unless otherwise approved by the engineer.

Waste concrete and masonry shall be disposed of in the areas indicated on the Drawings or as directed by the engineer. In no case shall discarded materials be left in piles adjacent to or within the site limits. The manner and location of disposal of materials shall be subject to the approval of the engineer and shall not create an unsightly or objectionable view.

All suitable materials from Clearing, Grubbing shall be stockpiled in designated area for reuse purpose as directed by the engineer.

The removal of existing utilities not under the jurisdiction of hospital or site premises which is required to permit orderly progress of work shall be accomplished by the relevant local agency unless otherwise shown on the Drawings. Whenever such power or telephone pole, pipeline, conduit, sewer, roadway, or other utility must be removed or relocated, the Contractor shall advise the engineer who will notify the proper local authority or owner and attempt to secure prompt action.

304 Clearing, Grubbing and Removals

In areas designated to be cleared and grubbed, all trees, stumps, down timber, logs, snags, brush, undergrowth, matted roots, hedges, heavy growth of grass or weeds, fences, debris, rubbish of any nature, natural obstructions and such material which in the opinion of the engineer is unsuitable for the foundation of required structures, shall be removed.

Rip rap or stone/ brick pitching designated for removal from channels shall be dismantled in a manner to salvage all stones/bricks. Stones/bricks from removal of rip rap or stone pitching shall be cleaned or washed and stacked in designated area for reuse in stone/brick lining/ pitching after cleaning and reshaping channel. No separate payment shall be made for cleaning of stone, bricks.

Dismantling for masonry and concrete works shall be treated as single work irrespective of strength and type of materials (brick or stone or plain cement concrete or reinforced cement concrete). Trash-rack structures designated for removal from drainage channels shall be dismantled in such a manner to salvage existing fencing or other reusable materials.

Buildings, structures, foundations, wells, septic tanks, cesspools, and all like in-ground or above grade structures shall be fully demolished within earthworks grading areas. Notwithstanding the above, the roofs of all septic tanks, manholes, etc. shall be removed so that all voids within such structures can be backfilled with approved fill material. Broken concrete, concrete blocks, or other objectionable spoil

material which cannot be used in backfill shall be disposed of in designated areas. Such areas will be designated on the construction site in locations not in conflict with future developments.

All holes remaining after the clearing, grubbing and removal operation in embankment areas shall have the sides broken down to flatten out the slopes and shall be filled with acceptable material moistened and properly compacted in layers to the density required in these specifications. The same construction procedure shall be applied to all holes remaining after the clearing, grubbing and demolition operation in excavation areas where the depth of holes exceeds the depth of the proposed excavation.

305 Measurement for Payment

Measurement for clearing and grubbing of area designated and removal of all structures above or below existing ground as required by these specifications, as shown on the Drawings, or directed by the engineer will be on the basis of unit of corresponding items in the Bill of Quantities.

306 Basis of Payment

Payment for removal of all structures above or below ground, as required by these specifications, as shown on the Drawings, or as may be directed by the engineer will be at the contract unit price for each item tendered in accordance with the Bill of Quantities. The Contract price shall be full compensation for all activities required including supply of material, transportation, labour, equipment and incidentals to complete the work in all respect specified otherwise.

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400 EARTHWORKS

401 Scope of Works

401.1 General

a) Scope of Application

This section shall apply to the execution of all earthwork, backfilling, filling, and disposal necessary for the construction of all the buildings. Earthwork shall be done according to the dimensions and cross sections of the structure as shown on the Drawings or as instructed by the engineer.

b) Definition of Earthwork Materials

The following definitions of earthwork materials shall apply:

(i) "*Top soil*" shall mean the top layer of soil that can support vegetation. It shall include all turf acceptable for turfing.
(ii) "*Rock material*" shall comprise material, which in the opinion of the engineer can be removed either with drilling and blasting with explosives or continuous manual chiseling or mechanical chipping with pneumatic tools.
(iii) "*Common material*" shall comprise all material that is not classified as rock material. Common material shall include soil mixed with boulders that need not to be blasted.
(iv) "*Suitable Material*" shall mean all excavated material that can be used as construction material in the Works in accordance with these Specifications.
(v) "*Unsuitable materials*" shall mean material other than suitable material. Material from swamps, marshes, bogs, organic material, silt, and clay or their mixture, discarded top soil etc. in general are unsuitable material.

Classification of common and rock material made by the engineer shall be final and binding on the Contractor.
Measurement will be limited to the lines, grades, slopes, and dimensions shown on the drawings or as directed by the engineer.

Original lines and levels of surfaces for measurement of depth shall be determined by Contractor and submitted to the engineer for approval before commencement of excavation and will be arithmetic mean of representative levels taken at suitable intervals prior to the execution of all earthworks.

c) This work generally to be executed by the Contractor shall include the followings:

(i) Structural excavation for foundations
(ii) Segregating good material from structural excavation backfilling and compacting
(iii) Imported filling material as necessary
(iv) Disposal of surplus materials
(v) Filling under slabs
(vi) Anti-termite treatment
d) Standards

Work shall comply with IS 3764: 1992 Excavation Work – Code of Safety, IS 9759: 1981 Guidelines for Dewatering during Construction or equivalent international standards as approved by the engineer.

401.2 Description of the Work

a) Ground Water Level

i) The Contractor shall carry out his own survey on the underground water level and incorporate these survey results into the method statement for Earthworks.
ii) No additional payment will be allowed for any delays, additional work, or additional costs related to any increase, decrease or seasonal changes in the water table level.

b) Working Directions

i) The working methods and equipment for Earthwork shall take into account the nature of soils, and the presence of the water table at shallow depth, and at variable levels in most cases.

ii) When, in the opinion of the engineer, dewatering equipment or pumping is required then the Contractor shall submit a proposal for a suitable dewatering method with analysis for the effect of dewatering to the surrounding area so as to keep foundations in dry condition at any stage of work, the water shall be drained away from the site through sub drain and connecting into main drain, stacking the excavated earth at proper place near site for refill using mechanical means and shall implement this after the approval of the engineer at the contractor's own cost.

iii) The Contractor shall keep excavations free from all ground, running and surface water at all times. Water from excavations shall not be permitted to flow directly into new drains or other construction work. Where dewatering equipment or pumping is necessary, the material in and around the excavations shall not be disturbed by pumping, and all sumps shall be formed clear of excavations for permanent work.

- Water pumping at all low points shall be provided continuously until the permanent drainage systems are finished and connected to the drainage network.
- Temporary drains shall be built as excavation progresses.
- Effective temporary settlement basins shall be installed before the water is drained into recently completed drainage systems.
- The drainage network for water coming from the work area, whether it is included in the job-site or downstream, shall be permanently protected against pollution, maintained and kept clean until the end of work.

iv) Any failure to comply with the preceding rules shall result in the suspension of the part of the works in question by the engineer, and the Contractor shall be responsible for all measures and all costs incurred thereto.

v) The Contractor shall organize each section of the Earthwork in a controlled and efficient manner so as to minimize the exposure of sub grades and bottoms of excavations to the weather.

vi) All excavated material if not used for backfilling shall be carefully removed from the site to a disposal location outside the construction site to be selected by the Contractor.

402 Excavating

402.1 Basic Workmanship for Excavation

a) Disposal of Excavated Materials

Materials arising from the excavations are to remain the property of the Employer. The materials arising from excavations shall be used for the back fill and leveling of the site and only the excess materials shall be removed from the site to a disposal location outside the construction site to be selected by the Contractor only after the approval of the engineer.

b) Benching

Surfaces of excavations with a gradient greater than 1 in 5, which are to receive filling, must have horizontal benches cut to match the depths of compacted layers of filling.

c) Adjacent Excavations

Where an excavation encroaches below a line drawn at an angle of 45° from the horizontal from the nearest formation level of another higher excavation, all works within the lower excavation and backfilling thereto must be completed before the higher excavation is made.

d) Accuracy

Permissible deviations from formation levels:

- Beneath mass concrete foundations: +/- 25 mm
- Beneath ground bearing slabs and reinforced concrete foundations: +/- 15 mm
- Embankments and cuttings: +/- 50 mm

- Ground abutting external walls: +/- 50 mm, but such as to ensure that finished level is not less than 150 mm below damp proof course.

e) Formations General

Advance arrangements (minimum 4 working days) must be made with the engineer for the inspection of formations for the following:

- Foundations
- Ground slabs
- Roads and Paved areas
- Trenches and Chambers
- Remove the last 50mm of excavations just before inspection. Trim excavations to required profiles and levels, and remove all loose material.
- Unless otherwise instructed, cover formations within 4 hours of inspection with concrete or other specified fill.

f) Foundations General

Obtain instructions if:

- A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
- The formation contains soft or hard spots or highly variable material.

g) Foundations in Made Up Ground

Excavate down to a natural formation of undisturbed subsoil. Obtain instructions if this is at a lesser depth than that shown on the drawings.

h) Unstable Ground

Inform the engineer without delay if any newly excavated face will not remain unsupported sufficiently long to allow the necessary earthwork support to be inserted. If the instability is likely to affect adjacent structures or roadways, take appropriate emergency action until instructions are obtained.

i) Recorded Features

Break out old foundations, beds, drains, etc. where and to the extent instructed by the engineer. Seal off drain ends, remove contaminated earth and disinfect as required by the engineer. Backfill as specified.

j) Unrecorded Features

Where old foundations, beds, basements, filling, tanks, service pipes, drains, etc. not shown on the drawings are encountered, obtain instructions from the engineer before proceeding.

k) Existing Watercourses

Existing watercourses which have been diverted and are to be filled must be cleared of all vegetable growth and soft deposits before filling.

l) Excess Excavation

Backfill any excavations taken:

- Wider than required with the material specified for backfilling.
- Deeper than required with well graded granular material or lean concrete mix.

402.2 Excavations General

a) Excavation for foundations, ground floor beds, paving, etc. shall be carried out to the dimensions, lines and levels, as indicated on the Drawings. Excavation shall be executed in such a manner that the required final level is reached solely by removal of material. Wherever excavation has been taken below the final level, the Contractor shall fill back to the final level at his own expense, with 'approved materials' to the approval of the engineer. Such 'approved material' may consist of approved granular material or in-situ mass concrete, where so deemed necessary by the engineer.

b) Surveys shall be made by the Contractor in the presence of the engineer, of all areas of excavation and filling before any work is carried out under the Contract, and after all excavation and filling work has been completed. When plans or sections prepared from the above surveys have been agreed between the engineer and the Contractor as truly representing the original ground levels and the

final levels as required by the Contract, the same shall be signed and become record surveys for the assessment of earthwork quantities.

c) The Contractor shall notify the engineer sufficiently in advance of the beginning of any excavation so that the engineer may make cross-sectional elevations and measurements of undisturbed ground. Natural ground or embankment at or adjacent to any structure shall not be disturbed without the permission of the engineer.

d) Trenches, foundation pits for structures or structural footings shall be excavated to lines and grades or elevations shown on the Drawings or as subsequently directed by the engineer and shall be of sufficient size to permit placing of structures or structural footings of the full width and length shown.

e) In certain instances, elevations of bottoms of footings as shown may be considered as approximate only and the engineer may order, in writing, such changes in dimensions or elevations of footings as may be deemed necessary, to secure a satisfactory foundation.

f) Boulders, logs, and any other objectionable material encountered in excavation shall be removed to the disposal area.

g) After each excavation is completed, the Contractor shall notify the engineer and no footing, or other material shall be placed until the engineer has approved the depth of excavation and character of exposed foundation material. Any concrete or other work put in before the excavation has been inspected and approved, shall, if so directed by the engineer, be removed at the Contractor's expense.

h) The bottoms of excavations shall be cleaned of all loose material and cut to a firm surface, either level, stepped, or serrated as directed by the engineer. All seams or crevices shall be cleaned and grouted and all disintegrated hard material and thin strata shall be removed.

i) When the footing is to rest on material other than rock, excavation to final grade shall not be made until immediately prior to placing of concrete foundation or filling.

j) When material at the bottom of excavation for foundation is soft or otherwise unsuitable, as determined by the engineer, the Contractor shall remove unsuitable material and backfill with approved granular material placed and compacted in 150mm layers up to foundation elevation.

k) The bottom of excavations shall be kept free from mud and water, trimmed clean, protected from the effects of weather and thoroughly compacted and consolidated by approved methods.

l) Sub-grades to ground floor concrete beds shall be fully compacted so that the dry densities over 300mm depth shall be at least equal to 95% of the maximum density during the normal Proctor compaction test performed on the excavated material.

m) The sub-grades must be accepted by the engineer before any of the layers covering them are placed. The sub-grades shall be covered immediately after their acceptance.

- The sub-grade adjustment tolerance shall be +20mm.

n) Any traffic threatening to cause deformations of accepted sub-grades shall be forbidden. Suitable protective action such as the following must be implemented:

- Organize the site so that materials are supplied without moving over work areas already in place.
- Use low-pressure type equipment.

o) In case of any damage caused to the sub-grades, this shall be repaired by the Contractor at his own cost.

402.3 Excavation of Pits and Foundation Trenches

a) Where required by the nature of the materials to be excavated or the nature of the structure to be accommodated, the Contractor shall provide all necessary sheet piling, planking, strutting and shoring required to safely and securely uphold the face of the excavation or any adjacent structures and provide any necessary staging. The Contractor shall be responsible for the design, supply, fixing and removal of all sheets piling and planking and strutting required. The sheet piling, planking and strutting shall be of sufficient strength to resist all anticipated loading, to ensure the safety of the workmen and to prevent damage to any adjoining property. The engineer may direct that such supports be left in position.

b) Alternatively, subject to the prior approval of the engineer and at no additional expense, the face of the excavation may be suitably battered.

c) Foundation trenches and pits shall not be wider than is necessary for the works to be carried out.

d) The bottom of all excavations shall be to the correct levels as shown on the Drawings. Any pockets of soft material or loose rock in the bottom of pits and trenches shall be removed and the resulting cavities and any large fissures filled with concrete. After the placing of any blinding concrete required by the Contract, no trimming of the side faces shall be carried out for 24 hours.

e) The excavation tolerances for foundations with respect to the specified levels shall be –30mm and +10mm.

f) If the Contractor does not comply with this tolerance, he shall execute at his cost the following:

- Either adjustment by soil removal, or
- Filling of excess depths with blinding concrete.

g) The excavation bottoms shall be adjusted as the excavations are finished. As soon as the bottom is accepted by the engineer, sand gravel filling shall be placed and compacted immediately.

403 Timbering of Foundations

When foundations are to be taken deep, the sides of the trenches shall be protected by erecting tin shoring and structuring. Timbering shall be close or open depending on the nature of the soil and work, arrangement of timbering, sizes and spacing of members shall be as directed by the engineer. Nothing else on his account shall be admissible which required special treatment for purpose of excavation; it shall deem to be excavation in soil. Ordinary pebbles or canker shall be taken as soil for which nothing else shall be paid.

404 Shoring and Protection

Where necessary to do shoring the Contractor shall be responsible for the design of shoring for pre excavation. The engineer must approve the design and shop- drawing of shoring. Shoring shall be sufficient strength to resists side pressure ensuring safety from slips, prevent damage to work and property injured to persons. It shall be removed as directed after all the items for which it is required are completed.

Near towns and all frequented places, foundation pits well pits and similar excavation shall be sequenced and red lights used in night. This should be in the charge of watchman to avoid accidents. Adequate protective measures required for the safety of the excavation, the people working and near foundation trenches, the Contractor should take property and the people in the vicinity. The Contractor shall be entirely responsible for any injury to life and damage to property caused by the negligence accidents due to his constructional operations. No extra shall be paid in this connection unless other.

405 De-Watering

The contractor shall pump out all water, which may accumulate in excavation during the progress of the work either from seepage, springs rain or any other source until otherwise specified in the contract at contractor's own cost.

Pumping water from any foundation enclosure or trenches shall be generally in such a manner as to precede the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structures. The excavation shall be kept free from water.

1) During inspection and measurement,

2) When concrete and masonry is in progress and till they come above the natural water level and

3) Till the Engineers consider necessary.

406 Trimming and Leveling

The bottom of all foundation should be trimmed and leveled in accordance with the drawing. Bottom of foundation shall be rammed and watered if dry before concrete is deposited.

407 Disposal

Surplus Subsoil

All excavated subsoil material, as far as suitable, shall be utilized for backfill or embankment. Any excavated surplus subsoil that it not required for
or embankment or not required to be retained by the Employer at the construction site shall be removed from the construction site to a disposal site to be selected by the Contractor.

408 Filling

408.1 Filling Generally

a) Hazardous, Aggressive or Unstable Materials

i) Do not import or use fill material which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling.
ii) Soluble sulphate content (SO_3) of imported materials for filling under concrete slabs or within 1 m of substructures must not exceed 1g/litre when tested to BS 1377:Part 3, clause 5 using a 2:1 water-soil extract. Submit test reports from an approved laboratory demonstrating the compliance of the proposed material(s).

b) Placing Fill Generally

i) Ensure that excavations and areas to be filled are free from loose soil, rubbish and standing water.
ii) Take all necessary precautions to ensure the stability of adjacent structures. Place and compact fill against structures, membranes or buried services in a sequence and manner, which will ensure stability and avoid damage.
iii) Plant and equipment employed for transporting, laying and compacting material must be suited to the type of material in question.
iv) Lay differing materials separately so that only one type of material occurs in each layer.

c) Benching in Fill

Where, during the progress of the work, the difference in level between adjacent areas of filling exceeds 600 mm, cut into the edge of higher filling to form benches having a minimum width of 600 mm and a height equivalent to the depth of a layer of compacted filling. Then spread and compact new filling to ensure maximum continuity with the previous filling.

408.2 Filling in Making Levels

a) General

i) Select well-graded granular material, arising from the structural excavation or imported material as defined below. Material if excavated, then a sufficient quantity of suitable material should be selected and kept separately. If there is insufficient suitable excavated material, provide the engineer with details and obtain instructions regarding the importation of fill material.
- Well-graded sands and gravel with a uniformity coefficient of more than 10.
- Crushed hard rock or quarry waste (other than chalk).

ii) Filling shall be compacted to a minimum 95% of maximum dry density based upon ASTM D-698.
iii) Maximum layer thickness for filling shall be 200mm.
iv) Quality of compaction shall be monitored in an independent testing laboratory in accordance with BS1377: Part4; Part5 and Part9 of the 1990 procedures or the relevant Japanese standards or equivalent international standard as approved by the engineer.

b) Protection of Compacted Filling

i) Do not allow construction traffic on compacted cohesive soil filling until the level has been raised not less than 150mm above formation level by properly compacted temporary protective filling.
ii) Remove temporary protective filling from Site before beginning permanent construction.

c) Backfilling in Foundations

i) Under concrete foundation and ground slab or paving unless otherwise shown in the Drawings: Sand Gravel shall be used.
ii) Under grassed or landscaped areas: excavated material laid and compacted in layers not exceeding 300mm thickness.

408.3 Gravel Packing (Boulder and Sand Filling)

a) Material

i) Material shall consist of hard, durable, dense crushed natural rock gravel (gradation 6mm-75mm) with blinding sand, free of dirt, organic matter or other objectionable material.
ii) The modified CBR of the aggregate shall be not less than 95%.

b) Gravel under Concrete

Gravel under foundations shall be a minimum thickness of 300 mm thick. Excavate extra material or increase thickness of filling as instructed by the Engineer.

c) Blinding

i) Surfaces to receive sheet overlays or concrete shall receive sufficient blinding sand, fine gravel, pulverized fuel ash (PFA) or other approved fine material applied to fill interstices and provide a close smooth surface.
ii) Permissible deviations on surface level: +0 / -25mm.

d) Compaction

The compaction of the gravel packing works shall be done using 8-10 ton smooth wheeled roller.

409 Additional Lift

Extra payment shall not be made for extra lift involved, under this item.

410 Measurement and Rates

410.1 Measurement

a) The quantity shall be computed from the Drawings and measurement and payment shall only be against the pay items contained in the Earthwork Section of the Bill of Quantities.

b) Common excavation to reduce levels shall be measured in cubic meters (m^3) the volume computed from the plan area measured from the Drawings; commencement level will be as determined by site survey and finished level as required by the Drawings or the engineer's instruction.

c) Structural excavation shall include pits, trenching and connecting tie beams excavation and shall be measured in cubic meters (m^3). The volume shall be computed net, based upon the net plan area necessary to accommodate the permanent reinforced concrete foundation work as measured from the Drawings and with depths measured from the Drawings or to levels instructed by the engineer.

d) Disposal volume shall be measured in cubic metres as the theoretical difference between total measured excavated volume (including topsoil) and the total measured volume of backfilled topsoil and other excavation.

e) No allowance will be made for bulking.

f) Backfilling and filling to make up levels shall be measured in cubic meters (m^3). The quantity shall be computed net of the finished compacted volume of backfilling required with quantities taken from the Drawings.

g) Gravel packing shall be measured in cubic meters (m^3). The quantity shall be computed net of the finished compacted volume of filling/foundation required with quantities taken from the Drawings.

410.2 Rates

a) The rates shall be full compensation for all plant, materials, labour, equipment, transport, temporary works, establishment charges overheads, and profit required to complete the work described in this Specification.

b) Rates shall include for removal of all water by whichever means necessary.

c) Rates for common excavation shall be deemed to include for:
   i) Clearing areas of excavation
   ii) Forming any trial holes to locate existing services, cables or drains
   iii) Excavating and filling by hand or machine
   iv) Excavating in any material likely to be encountered including all clays, sands, silts, old foundations, etc.
   v) All necessary supports and protection to uphold and maintain sides of excavation and adjacent structure
   vi) All required additional volume or working space including any additional volume of excavation, backfilling, filling, disposal and all other additional cost associated therewith.
   vii) Protection

d) Rates for structural excavation shall be deemed to include for:

   i) Forming trial holes to locate existing cables or drains.
   ii) Excavating by hand or machine
   iii) Excavating in any materials likely to be encountered, including all clays, sands, silts, rocks, boulders or old foundations etc.
   iv) All necessary supports and protection to uphold and maintain sides of excavation and adjacent structure.
   v) All required additional volume or working space including any additional volume of excavation, backfilling, filling, disposal and all other additional cost associated therewith.
   vi) Protection

e) Rates for disposal shall be deemed to include for:

   i) Additional volume of bulking
   ii) Any multiple handling that may be required
   iii) Depositing carefully in designated locations as instructed by the engineer.

f) Rates for backfilling and filling to make up levels shall also be deemed to include for:

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i) Purchase and transportation to site for materials obtained off-site
ii) All multiple handling
iii) Selecting suitable material
iv) Earthwork support
v) Placing and consolidating in layers
vi) Finishing
vii) Protection

g) Rates for gravel packing shall also be deemed to include for:
i) Placing and consolidating in individual pieces or in layers as appropriate
ii) Formwork and finishing
iii) Protection

411 Basis of Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

PART 500 CEMENT CONCRETE WORK

501 Scope of Works

This section covers the supply of materials, mixing, placing and testing of concrete used in various works such as plain cement concrete, reinforced cement concrete, pre-cast concrete, plum concrete and curing as specified.

502 Materials and Storage

502.1 Cement

Cement used for concrete shall be any of the Portland cement conforming to the requirements of NS 49-2041.

Cement, which is stored on site, shall be kept in a room that provides adequate protection against moisture and other factors, which may promote deterioration. Cement shall not be kept in storage for longer than six weeks without the engineer's permission and different brands and/or lots of the same brand shall be stored separately.

When the cement is supplied in bags, they shall be closely and neatly stacked off on timber planks 150mm to 200 mm clear from the floor to a height not exceeding 12 bags and shall be arranged so that they can be used in the order in which they were delivered to the site. The gap between each bag of stacked cement shall be minimum 30 cm in order to circulate air.

Table 500.1: Requirements on the Physical Characteristics of Cement (As per IS 269:2015)

S.N.	Physical characteristics	OPC 53	Test Procedure
i)	Fineness, m^2/kg: (by Blaine's Air Permeability method)	225	IS-4031 Part 2
ii)	Setting Time: (a) Minimum Initial Setting Time (minutes) (b) Maximum Final Setting Time (minutes)	 30 600	IS 4031 Part 5
iii)	Soundness by Lechatelier method, mm, maximum	10	IS 4031 Part 3
iv)	Compressive Strength: Minimum Average Compressive Strength of three mortar cube(N/mm^2) (a) 3 days (b) 7 days (c) 28 days	 27 37 53	 IS 4031 Part 6

502.2 Aggregates

Both course aggregates (stone) and fine aggregates (sand) shall comply with the requirements of IS: 383-1970 subject to the following:

i) The Combined Percentage of Flakiness and Elongation index of coarse aggregates shall not exceed 40%.
ii) The Impact Value of coarse aggregates shall not exceed 45%.
iii) Deleterious materials should not exceed 5% for all aggregates.
iv) If there is a potential risk of alkali reaction to the aggregate the engineer's decision as to the suitability of the aggregate shall be final and binding.
v) The Aggregate Crushing Value (ACV) as determined in according with BS 812: Part 3 shall not exceed 30%.

vi) The crushed aggregate shall have a percent of wear not more than 50% for concrete at 500 revolutions under LA abrasion test, as determined by AASHTO T 96.
vii) Grading of fine aggregates by sieve analysis.

viii) The crushed aggregate shall not show evidence of disintegration nor show a total loss greater than 5% when subjected to 5 cycles of the sodium sulfate accelerated soundness test using AASHTO T 104.

Aggregates of different nominal sizes shall be stored separately and in such a way that segregation is avoided. Intermixing of different materials and contamination by foreign matter shall be avoided at all times.

Table 500.2: Tests Procedures Applicable to Stone Aggregate and Fillers

Tests	Test Procedure	
Determination of:		
i) Particle Size Distribution(Gradation)	IS 2386	Part 1
ii) Clay, Silt, Dust in Aggregates	IS 2386	Part 2
iii) Flakiness index	IS 2386	Part 1
iv) Specific Gravity	IS 2386	Part 3
v) Moisture Content	IS 2386	Part 3
vi) Bulk Density, Voids & Bulking	IS 2386	Part 3
vii) Soluble Chloride Content	BS812	Part 117
viii) Mica Content	Manual mineralogical counting	
ix) Water Absorption	1S2386	Part 3
x) Crushing Ratio	Manual counting	weighing
xi) Los Angeles Abrasion	IS 2386	Part 4
xii) AIV - ACV	IS 2386	Part 4
xiii) Polished Stone Value	IS 2386	Part 4
xiv) Degradability Test	NFP94-067	
xv) Sodium Sulphate Soundness	IS 2386	Part 5
xvi) Alkali Aggregate Reactivity Test	IS 2386	Part 7
xvii) Deleterious Substances	IS 2386	Part 2
xviii) Sand Equivalent	IS 2720	Part 37
xix) Crushing Strength of stone	IS 2386	Part 4

502.3 Water

Water shall be clean and free from detrimental concentration of acids, alkalis, salts, and other organic or chemical substances. If the water used is not obtained from drinking water source the engineer may require the Contractor to have the suitability of the water proved by tests carried out by an approved laboratory. Such tests shall comply with the requirements of IS: 3029-1964.

502.4 Bonding Chemical for Concrete

An eco-friendly, milky white styrene butadiene latex used for high performance applications in waterproofing and repairs which is used with cement, concrete and plaster to improve waterproofing, new to old concrete/plaster bonding.

Technical Data:

Properties	Result
Appearance	Free flowing liquid
Color	Milky White

Specific Gravity @30 degree Celsius gms / ml	1.02+0.02
Non Volatile matter,	% 42-44
PH value	7-9
Bond strength, N/sq mm	5
Chemical resistance	Resists mild acids & alkalies
Freeze thaw resistance	Excellent
Coverage	1 kg of Bonding chemical will cover 70-80 sq.ft area in 2 coats for a proportion mix 1:4:7 (Bonding Chemical : Water : cement)
Shelf Life	One year from the date of manufacture

502.5 Concrete Quality

➢ **Design Mix**

Table 500.3 Concrete Quality (Design Mix)

A-1	**Stipulations for Proportioning**		
1	Grade Designation	M20	M25
2	Type of Cement	OPC 53 grade confirming to IS-269-2015 & NS 572	OPC 53 grade confirming to IS-269-2015 & NS 572
3	Maximum Nominal Aggregate Size	20 mm	20 mm
4	Minimum Cement Content	250 kg/m^3	310 kg/m^3
5	Maximum Water Cement Ratio	0.5	0.45
6	Workability	25 mm (Slump)	50-75 mm (Slump)
7	Exposure Condition	Normal	Normal
8	Degree of Supervision	Good	Good
9	Type of Aggregate	Crushed Angular Aggregate	Crushed Angular Aggregate
10	Chemical Admixture Type	Superplasticiser Confirming to IS-9103	Superplasticiser Confirming to IS-9103
A-2	**Target Strength for Mix Proportioning**		
1	Target Mean Strength	26.6N/mm^2	31.6N/mm^2
2	Characteristic Strength @ 28 days	20N/mm^2	25N/mm^2
A-3	**Proportion of Volume of Coarse Aggregate & Fine Aggregate Content**		
1	Vol. of C.A. as per table 3 of IS 10262	62.00%	62.00%
2	Adopted Vol. of Coarse Aggregate	65.00%	62.00%
3	Adopted Vol. of Fine Aggregate (1-0.65)	35.00%	38.00%

The following items shall be issued to describe the class of concrete required:

i) Ordinary structural / Mass Concrete (Cast in Situ or Ready-Mix Concrete)

This is concrete of any class, which is used, in reinforced, pre-stressed, plain concrete construction including prefabrication with:

- Portland cement complying with the requirements of NBSM 49-2041.
- Aggregates from natural sources, complying with IS 383-1970.
- Water which is clean and free from harmful matter and complying with IS 3029-1964.
- Any kind of admixtures, if required.

Note: Contractor need to take an approval for Cast in Situ or Ready-Mix Concrete before concreting.

➢ **Prescribed Mixes:**

Concrete mix in this category shall be proportioned by volume. The Engineer may instruct to slight adjustment in the proportioning to allow for variations in the specific gravity and grading of aggregates. Such variation shall not be deemed to vary the price of the concrete. The Engineer shall require the contractor to make trial mixes and test work cubes to satisfy himself that the prescribed mix will give expected strengths. No concrete shall be placed in the works until the relevant mix has been approved by the Engineer and no variation shall be made in the mix after approval without the Engineer's consent, who may require further tests to be made.

Prescribed mixes shall have the proportion mentioned below

Classes of Concrete	Characteristic Strength fck (N/mm2)	Maximum nominal size of Aggregate (mm)	Mix proportion in case of Prescribed mix (Cement: Sand: Aggregate)
M10/ 40	10	40	1:3:6
M15/ 40	15	40	1:2:4
M15/ 20	15	20	1:2:4
M20/ 20	20	20	1:1.5:3

503 Materials Measurement for Concrete Batching

503.1 Cement

Where cement is supplied in standard bags the bags shall be assumed to contain 50 kg. All cement taken from bulk storage containers and from partially used bags shall be batched by mass, to an accuracy of within 3 percent.

503.2 Water

Mixing water for each batch shall be measured, either by mass or by volume to an accuracy of within 3 percent.

503.3 Aggregates

All aggregates shall be measured separately be mass, except as otherwise provided in this Clause, to an accuracy of within 3 percent. Volume batching shall not be permitted for concrete grade M20 and above.

Batching boxes for volume batching shall be filled without tamping, ramming, or consolidation of any kind (other than that occurring naturally during the filling process), and shall be screed off level with their topmost edges. Any adjustment of the volume shall be made by supplementary containers of a suitable size. Adjustments by the incomplete filling of batching boxes shall not be permitted.

Fine aggregate shall be tested for bulking at the beginning of and half way through each concreting shift and adjustment shall be made to the batch volume to give the true volume required.

The measurement of cement in gauge boxes will not be permitted and volume batching shall be planned to use whole bags of cement.

503.4 Admixtures

Any solid admixtures to be added shall be measured by mass, but liquid or paste admixtures may be measured by volume or mass. The quantity shall be measured to an accuracy of within 5 percent.

503.5 Silica Cement Admixture

Silica Cement Admixture shall be white amorphous substance having particle size of 0.4 micron with specific surface area of 6000 cm^2/gram obtained from natural volcanic ash containing silicon dioxide above 85% (SiO_2) as chief ingredient.

503.6 Adjustment of Mix Proportions

During production adjustments of mix proportions may be made in order to minimize the variability of strength and to approach more closely the target mean strength. Such adjustments are regarded as part of the proper control of production but the specified limits of minimum cement, content and maximum water/cement ratio shall be maintained. Changes in cement content shall be declared. Such adjustments to mix proportions shall not be taken to imply any change to the current margin.

504 Mixing

504.1 General

An experienced operator shall conduct mixing of material for concrete. Unless otherwise approved, mixing shall be carried out in a mechanical batch mixer of approved type and capable of producing a uniform distribution of ingredients through the batch. Calibration of the weighing mechanism of any batching plant shall be carried out on site in the presence of the engineer prior to start of production and at such intervals as the engineer may determine.

504.2 Charging the Mixer

The engineer shall approve the sequence of charging and, unless otherwise instructed, the same sequence shall be maintained. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

504.3 Mixing and Discharge

The period of mixing shall be measured from the time when all materials are in the drum until the commencement of discharge. The mixing period shall be 90 seconds and may only be reduced if, on the basis of site tests, the engineer is satisfied that the reduced mixing time will produce concrete having essentially the same strength and uniformity as concrete mixed for 90 seconds.

The reduced mixing time shall be, however, not less than 50 seconds or the manufacturers recommended mixing time, whichever is the greater. A suitable timing device shall be attached to the mixer to ensure that the maximum mixing time is complied with.

The first batch to be run when starting with a clean mixer shall contain only 2/3 of the required amount of coarse aggregate to facilitate "coating" of the mixer drum.

Discharge shall be so carried out that there is no segregation of the materials in the mix. The mixer shall be emptied completely before it is recharged.

504.4 Maintenance and Cleaning of the Mixer

If the mixer has stopped running for any period in excess of 30 minutes, it shall be thoroughly cleaned out, particular attention being paid to the removal of any build up materials in the drum, in the loader, and around the blades or paddles. Worm or bent blades and paddles shall be replaced. Before any concrete is mixed, the inner surfaces of the mixer shall be cleaned and all hardened concrete shall be removed.

504.5 Stand by Mixer

When casting sections where it is important that casting should continue without interruption a standby mixer shall be held in readiness to run on 15 minutes notice in case of breakdown of the stock mixer.

505 Placing & Compaction

505.1 General

Concrete shall be transported and placed in a manner that will prevent segregation, or loss of constituent materials and contamination. Concrete shall not be placed in any part of the works until the engineer's approval has been given. If concerting is not started within 24 hours of approval being given approval shall again be obtained from the engineer.

Concreting operations shall only be carried out during daylight hours unless proper lighting arrangements have been made and lights are in working order by noon. Workman shall but be allowed to work double shifts and the Contractor shall provide a fresh team for nightshifts.

The placing and compaction of concrete shall at all times be under the direct supervision of an experienced concrete supervisor. The slump measured at site shall have following values.

- Mass Concrete < 50 m
- Structural Concrete (dimension <50cm) < 70 mm
- Underwater Concrete < 100 mm

Once concreting has begun it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 15 minutes from completion of mixing and within one hour from the start of mixing. All excavations and other contact surfaces of an absorbent nature such as timber shall be damp but no free water shall be permitted to remain on these surfaces. The formwork shall be cleaned internally.

505.2 Placing

Weather possible concrete shall be deposited vertically into its final position. Where chutes are used the length and slope shall be such as not to cause segregation and suitable spouts or baffles shall be provided at the lower end to prevent segregation. This displacement of concrete by vibration instead of direct placing will not be allowed.

Concrete shall not be allowed to fall freely through a height of more than 1.5m. Fresh concrete shall not be placed against concrete that has been in position for more than 30 minutes unless a construction joint is formed.

Pumping of concrete shall be subject to the approval of the engineer. Aluminum pipes shall not be used for this purpose.

505.3 Placing Under Water

Normally concrete shall only be placed in the dry. Placing under water shall be allowed only exceptional circumstances where in the opinion of the engineer it is not feasible to water before placing. No concrete shall be placed in flowing water. Underwater concrete shall be placed by means of tremies. Full details of the method proposed shall be submitted in advance to the engineer for his approval. Placing by skip or pipeline will also be considered in certain circumstances.

During concreting by tremies, air and water must be excluded from the tremies by keeping the pipe filled with concrete at all times. In charging the tremies a plug formed of suitable paper of sacking shall be first inserted in the top of the pipe. Once concreting has begun the discharge end of the tremies shall be kept well below the surface of the concrete. Should this seal be broken the tremies shall be lifted and plugged before concerting is recommenced. Distribution of concrete by lateral movement of the tremies will not be permitted.

During and after concreting under water, pumping or dewatering operations in the immediate vicinity shall be suspended until the engineer permits them to be continued.

The concrete mix used for under water placing shall be specifically designed and approved for this purpose to ensure good flow ability, plasticity and cohesion. Increased sand and cement contents over normal mixes will usually be required.

505.4 Compaction

Concrete shall be fully compacted by approved means during and immediately after placing. It shall be thoroughly worked against the formwork around the reinforcement, tendons, ducts and embedded fittings and into corners to form a solid mass free from voids. The concrete shall be free from honeycombing and planes of weakness and successive layers of the same lift shall be thoroughly bonded together.

The concrete shall be compacted by means of vibration as approved by the engineer. Internal vibrators shall be capable of not less than 10,000 cycles per minute and external vibrators not less than 3,000 cycles per minute. Sufficient standby vibrators in working condition shall be held available in case of breakdown.

Vibrators shall be applied by experienced labour and over vibration resulting in segregation, surface water and leakage shall be avoided. Contact with reinforcement and formwork shall as far as practicable be avoided when using internal vibrators. Concrete shall not be subjected to disturbance by vibration within 4 to 24 hours after compaction.

Whenever vibration is applied externally, the design of the formwork and positioning of vibrator shall be such as to ensure efficient compaction and avoidance of surface blemishes all subject to prior approval of the engineer.

Special attention shall be given to the compaction of concrete in the anchorage zones and behind the anchor plates and in all places where high concentrations of reinforcing steel or cables occur.

In such cases where the placing and compaction of concrete is difficult a mix containing small size aggregate may be used but only with the approval of the engineer and after a mix containing such aggregate has been designed and tested.

506 Cutting & Protection

Formwork shall be retained in position for the appropriate times as given in Table 500-5 and, as soon as practicable in the opinion of the engineer, all exposed concrete surfaces shall be protected from loss of moisture by one or more of the following methods:

a) Ponding the exposed surfaces by means of water, except where atmospheric temperatures are low i.e. less than 5°C.
b) Covering with sand, or mats made of moisture retaining material and keeping the covering continuously wet.
c) Continuous spraying of the whole area of the exposed surfaces with water (only on surfaces where Ponding or sand cover is not possible).
d) Covering with waterproof or plastic sheeting firmly anchored at the edges.

507 Adverse Weather Conditions

507.1 Cold Weather

Concrete shall not be placed during falling temperatures when the ambient air temperatures falls below 7°C or during rising temperatures when the ambient air temperature is below 3°. When placing concrete at air temperature below 5°C the concrete temperature shall not be below 10°C.

The temperature of placed concrete shall not be allowed to fall below 50 until the concrete has attained strength of at least 5 MPa and the Contractor shall be responsible for all protective measure necessary to ensure this. All concrete that has been damaged by frost or the formation of ice in the concrete shall be removed and replaced by the Contractor at his own expense.

507.2 Hot Weather

When the ambient air temperature exceeds 32°C during a concreting operation the Contractor shall take measure approved by the engineer to control the temperature of the concrete ingredients so that the temperature of the placed concrete does not exceed 25°C. Such measures will include spraying aggregate stockpiles with water to promote cooling down by evaporation and where feasible shading of stock pipes and the area where concreting is carried out. Curing shall commence immediately after placing of the concrete to prevent excessive moisture loss.

508 Pipes & Conduits

No pipes and conduits other than those shown on the drawings shall be embedded in the concrete without the engineer's approval. The clear space between such pipes or any reinforcement shall be at least 40 mm or the maximum size of the aggregate plus 5 mm whichever is the greater. The amount of concrete cover over pipes and fittings shall be at least 25 mm.

The ends of all ferrules used for bracing formwork shall be neatly finished off the details shown on the Drawings. Where no details are given on the Drawings ferrules shall be cut back and the holes filled in with mortar and finished off flush with the concrete surface.

509 Applied Loading

No load shall be applied to any part of a structure until the specified curing period has expired, and thereafter, applied loading shall only be allowed after approval by the engineer. The engineer's decision will be based on the type of load to be applied, the age of the concrete, the magnitude of stress induced and the propping of the structure.

No structure shall be opened to traffic until test cubes made of the concrete in all parts thereof have attained the specified minimum 28-day strength.

510 Testing & Quality Control

The Contractor's minimum obligations for testing and quality control in concrete work shall be the following:

510.1 Testing of Aggregates

Coarse aggregates shall be tested for grading once for every 6 m^3 delivered on site and fine aggregate once for every 5 m^3 delivered, or more if considered necessary by the engineer.

510.2 Testing of Concrete

Normal and Accelerated Strength Tests.

Testing of 28 day crushing strength of concrete shall be controlled not less than the following frequencies:

Volume of lot	No. of tests per lot
< 75 m^3	3
75-150 m^3	4
> 150 m^3	5

A test shall be the average test value for three cubes prepared from the same batch of concrete, the samples being consolidated in the moulds by Roding as per BSI 1881.

In the case of major structures, the Contractor is advised to carry out regular accelerated compressive strength tests in order to predict the 28 days' compressive strength of concrete. The methods of testing and predicting 28 day strengths shall be as determined in consultation with the engineer. Whenever accelerated tests indicate that the 28 day strengths will not be obtained to Contractor shall immediately effect such changes in materials and mix proportions as may be necessary to ensure future compliance.

When specified on the drawings the use of accelerated tests shall be obligatory.

a) Control Charts: The Contractor shall institute a system of control charts depicting tests results of all concrete 28-days strength and where applicable accelerated crushing strengths.

b) Provision of Records: The Contractor shall maintain written records that provide the following:

- Date on which each section concreted, class of concrete, time was taken to place, the position of the section in the works.
- Materials consumed
- Daily maximum and minimum temperature
- Nature of samples and dates on which they were, including identification makes.
- Results of tests on samples taken and description of concrete section represented by samples.

These records shall be maintained in a form agreed to by the engineer and shall at all times be up to date and available to the engineer for inspection.

511 Procedure in the Event of Failure

Any concrete represented by test cubes failing to meet the criteria specified for the characteristic strength shall be rejected, or,

a) The Contractor may apply for resubmission of the concrete in question on the basis of cores drilled to the approval of the engineer. The method of taking cores, testing them and evaluating the test results, shall be as instructed by the engineer. The procedure for determining compliance of test results shall be as specified by the engineer. The costs of drilling and testing the cores shall be for the Contractor's account regardless of the outcome of the tests on the cores. Before cores are taken, the members concerned shall be cured and allowed to age to at least 28 days but not more than 56 days.
b) Where the engineer so directs full-scale load tests shall be carried out accordance with his requirements to determine whether any structure or member can be accepted. The cost of such test shall be for the Contractor's account regardless of the outcome of the tests.

In all cases where concrete that fails to meet the requirements for strength has been produced the Contractor shall immediately take the required remedial action by changing the mix proportions to obtain the required strength.

512 Steel Reinforcements

512.1 Materials

The steel used for reinforcement shall be Thermo-mechanically treated (TMT) Bars with 0.2 Per cent Proof stress/ yield stress, Min, N/mm^2.

It shall have 16.0 elongation, per cent, Min. on gauge length 5.65 A, where A is the cross-sectional area of the test piece.

TMT bars shall conform to IS 1786 pertaining to Fe 500 D as specified.

It shall have no crack, scale or rust. Binding wire used to bind reinforcements shall be annealed galvanized binding wire of 20 gauge.

The ratio of the actual ultimate strength to the actual yield strength or the actual 0.2 percent proof strength of the reinforcement shall be at least 1.15 (NBC 105)

512.2 Binding

Bar steel reinforcement shall be bent cold to the forms and dimension shown on the drawings and in accordance with IS 2502. No heating will be allowed to facilitate bending. No welding or flame cutting will be allowed. Cold worked and hot rolled bars shall not be straightened or bent again once they have been bent.

512.3 Fixing

Reinforcement shall be clean and free from loose mill scale, rust, oil, grease, tar, paint mud, ice, retarders, concrete droppings and contamination by salts or other deleterious matter and shall be maintained in such condition up to the time of concreting.

Reinforcement shall be placed in accordance with the drawings and shall be supported and maintained in position by the provision of wire ties or clips at its correct position.

Spacers shall be securely fixed to the reinforcement at the time of placing concrete. Spacers shall be of cement mortar of the same strength as the concrete, or other approved material. Plastic spacer blocks shall not be used in the works. Effective measure shall be adopted to ensure that reinforcement remains accurately in position during the placing, compaction and setting of the concrete.

In slabs provide with two or more layers of reinforcement, the parallel layers of steel shall be supported in position by the use of steel chairs. Spacers shall be placed at each chair to support layers of reinforcement from the concrete carpet of formwork.

Reinforcement projecting from work already concreted shall not be bent out of its correct position for any reason and shall be protected from deformation or other damage. Except where otherwise shown on the drawing the length of lap joints shall be not less than 57 times the diameter of the larger bar.

Fabric reinforcement when laid adjacent to other sections of reinforcement or when lapped shall have a minimum lap of 300 mm for the main wires and 150 mm for the transverse wires. The use of off-cuts will not be allowed.

Except where otherwise shown on the drawings the concrete cover to the nearest reinforcement exclusive of plaster or other decorative finish and concrete binding shall be within 5 mm of the following.

a) For external work and for work against earth faces in liquid retaining structures - 50 mm,
b) For internal work in non-liquid retaining structures: like, beams and columns - 50 mm to the main steel and in no place less than 50 mm to the bar nearest the outside wall and slab reinforcement - 25mm to all bars or the diameter of the largest bar whichever is the greater.

The distance between any two parallel bars shall not be less than 25 mm or the diameter of the larger bar.

No concreting shall be commenced until the placed reinforcement has been inspected and approved. 48 hour notice shall be given to the engineer prior to any such inspection being required.

512.4 Testing

The contractor shall submit to the engineer, sample of reinforcement bar brand intended to be used for independent testing of Tensile Strength. And, **If the ratio of the actual ultimate strength to the actual yield strength or the actual 0.2 percent proof strength of the reinforcement shall be at least 1.15 (NBC 201:2015) then the test is acceptable, and material** is approved by the engineer. The contractor

may procure the approved material provided manufacturer's test certificate conforming to the specification for the lot is submitted to the engineer who reserve the authority to test each lot in case of suspect quality.

513 Plum Concrete

513.1 General

This work may be required to provide lining of drains and drainage structures or other works as specified by the engineer.

513.2 Materials

Ordinary Portland cement used shall conform to NS 49-2041.
Aggregates shall confirm to IS 383-1970
Water shall conform to IS 3025-1964.

Stone shall be of good, hard, durable quality, uniform in texture and free from iron bands, spots, sand holes, flaws, and other imperfections.

513.3 Composition

Composition of plum concrete, in general, will be 70 percent of concrete by volume and 30% percent stone of 100 mm. average size. The grade of concrete shall be as specified in the Contract. About 3% non-shrinking agent by weight of cement shall be added to concrete at the time of mixing.

513.4 Workmanship

The concrete for this work will need materials as specified in section 502.

Concrete will be prepared on a hard flat platform/space free from organic matter, oils. Soils and other materials detrimental to concrete, by mixing aggregates and cement in dry condition and then water will be added and mixture will be thoroughly worked to achieve proper workability and consistency. The concrete will be transported and placed within initial setting time of about 30 minutes at the place specified. The place or space to be filled with the concrete must be cleaned properly and chipped if possible so as to provide adhesion.

Clean stone of 100 mm size will be hand placed in the concrete during placing and tamped so that the boulders are surrounded completely on all sides by at least 100 mm thick concrete.

513.5 Mock-up

Prior to commencement of plum concrete, the Contractor shall construct a plum concrete panel of approximately 2000 mm x 1000 mm for inspection and approval of engineer. The thickness of mock-up shall be according to use of plum concrete in designated work.

514 Curing Of Concrete

514.1 General

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperatures differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete.

Curing shall be continued for as long as may be necessary to achieve the above objectives but not less than seven days or until the concrete is covered by successive construction whichever is the shorter period.

The above objectives shall be dealt with in Sub-clauses 515.2 and 515.3 but nothing shall prevent both objectives being achieved by a single method where circumstances permit.

The curing process shall commence as soon as the concrete is hard enough to resist damage from the process. In the case of large areas or continuous pours, it shall commence on the completed Section of the pour before the rest of the pour is finished.

514.2 Loss of Moisture

Exposed concrete surfaces shall be closely covered with impermeable sheeting, properly secured to prevent its removal by wind and the development of air spaces beneath it. Joints in the sheeting shall be lapped by at least 300 mm.

If it is not possible to use impermeable sheeting, the Contractor shall keep the exposed surfaces continuously wet by means of water spray or by covering with a water absorbent material which shall be kept wet, unless this method conflicts with Sub-clause 515.3.

Water used for curing shall be of the same quality as that used for mixing.

Formed surfaces may be cured by retaining the formwork in place for the required curing period.

If instructed by the engineer, the Contractor shall, in addition to the curing provisions set out above provide a suitable form of shading to prevent the direct rays of the sun reaching the concrete surfaces for at least the first four days of the curing period.

514.3 Limitation of Temperature Differentials

The Contractor shall limit the development of temperature differentials in concrete after placing by any means appropriate to the circumstances including the following:

(a) Limiting concrete temperatures at placing as set out in Clause 507;
(b) Use of low heat cement for mass concreting, subject to the agreement of client;
(c) Leaving formwork in place during the curing period. Steel forms shall be suitably insulated on the outside;
(d) Preventing rapid dissipation of heat from surfaces by shielding from wind.

515 Formworks

515.1 General

This work includes design, supply of timber scantlings, planks, GI sheets or steel forms, nails, nut-bolts, steel sections, erection or staging/scaffolding, propping, supports, fixing true to lines, levels and configuration, finishing exposed concrete surfaces after removal if found defective, control and removal of water, dismantling and finally removal of staging/scaffolding, centering and shuttering works.

The Contractor shall be responsible for the design of formwork. Formwork shall be constructed to attain the required surface textures of the structures and be such that it remains rigid and grout leak or loss shall not occur during the placing the setting of the concrete.

Formwork shall be fixed in perfect alignment and to the true shape and dimensions of the permanent work shown on the Drawings. A method of support, which would result in holes or tie wires extending through the full width of a member, will not be permitted. No deformation of the formwork will be allowed of the formwork whilst filling and full of concrete. Top formwork is to be provided to concrete faces where the slope exceeds one in four.

Before each concreting operation is commenced formwork shall be cleaned out of all rubbish, pieces of tying wire and water and the concrete contact faces of the formwork shall be fixed to ensure that no release agent comes in contact with reinforcement.

No concreting shall be commenced until the erected formwork and reinforcing steel has been inspected and approved. At least 48 hour notice shall be given of this request for inspection. On rejection for any reason a further noticed 48 hours will be required to inspect the rectified errors.

Structural concrete holes left after the removal of ties shall be carefully cleaned out and filled with concrete or mortar of an approved composition.

All exposed arises shall be chamfered 25 mm unless otherwise shown on the drawings. The inside surface of forms shall be coated with an approved material to prevent the adhesion of concrete. Such material shall be applied strictly in accordance with the manufacturer's instructions and shall not come in contact with the reinforcement or pre-stressing tendons and anchorages. The concrete shall not be marked or stained in anyway.

515.2 Type of Formwork

The following types of formwork will be used:

Type of Formwork	Grade
a. General Concrete work (wall/column footing, foundation bed pre-cast, terrace concrete, etc.)	A
b. Structural concrete work (dimension<50cm) for column, beams, slabs, etc.	B

515.3 Removal of Formwork

The Contractor shall give 24 hour notice of his intention of striking any formwork. Forms shall be removed without shock vibrations or other damage to the concrete.

Great care shall be exercised during the removal to avoid shocks or reversal of stress in the concrete. Formwork shall remain in place for the appropriate minimum period of time as given in Table 500-5, after placing of concrete. The time at which the formwork is struck remains the Contractor's responsibility.

Table 500-5: Time for Formwork to be in Place

Type of Work	Time for Formwork to be in place	
	Normal Weather (days)	Cold Weather (days)
Beam sides, walls and unloaded columns	1	1.5
Soffits of slabs and beams:		
a. Spans up to 3m	4	7
b. Spans over 3m to 6m	11	17
c. Spans over 6m to 12m	14	24
d. Spans over 12m	21	30

Notwithstanding the above the curing of the concrete shall continue for the full prescribed period by a method approved by the engineer.

515.4 Remedial Treatment of Concrete Surfaces

Any remedial treatment to concrete surfaces shall be inspected immediately after the stripping of formwork and shall be carried out within 2 hours. Surface defects such as small areas of honey-combing cavities, large isolated blow holes, broken corner edges, etc., shall be repaired with mortar consisting of a cement and sand ratio equal to that of the concrete being repaired. Under no circumstances will surface repairs be allowed where reinforcing steel is exposed. In this case the Contractor shall put extensive remedial works, such as demolition of concrete, forward. The forgoing shall be at the expense of the Contractor only.

515.5 Construction

The tolerance of the finished structures shall be as follows:

Grade A:	Horizontally	± 20 mm
	Vertically	± 10 mm
	Inclination	± 1.4 mm

Grade B: Dimensions of structural member's ± 10 mm, except for slab thickness and edge beams, where ± 5 mm is maximum.

516 Measurement for Payments

Measurement for payment for concrete, reinforcement and plum concrete shall be in the unit of relevant items of the Bill of Quantities.

All types of concrete (i.e. plain cement concrete, reinforced cement concrete, precast concrete, plum concrete) will be measured in number of cubic meters of finished concrete work to specified line, levels shown on Drawings or as directed by the engineer. Each class/grade of concrete shall be measured separately. No separate measurement will be made for additives and underwater concreting.

Measurement of reinforcement will be in number of kilograms of reinforcement as laid in final position to specified line, level as shown on Drawings or as directed by the engineer. Overlaps, coupling, spacer, bedding bars shall be included. The weight shall be calculated based on weight per unit length of bar.

Plum concrete work shall be measured in cubic meter of finished work to specified line, level as shown on Drawings or as directed by the engineer.

Measurement for formwork will be in square meter for area of formwork of different type in contact with concrete work specified and completed.

517 Basis of Payment

Payment will be made at the contract unit rate of all type of concrete, formworks and steel reinforcement works per cubic meter, per square meter and per metric ton or kilograms or as mentioned in the contract unit prices of relevant item in the BoQ(s). This price shall be full compensation for supply of materials, transportation, equipment, tools, scaffolding, labour and incidentals required to complete the respective work as specified. Each type of concrete shall be paid separately.

HELVETAS NEPAL

600 MASONRY WORKS

601 General

This item shall consist of brick or stone masonry works in dry or in cement or mud mortar and shall conform to the dimensions and drawings as directed by the engineer.

The contractor shall become familiar with other Sections of the specifications affecting work of this Section. All materials to be furnished and used that are not covered in this Section shall conform to the applicable requirements of other Sections

602 Samples & Mock-up

The Contractor shall submit ten (10) samples of the standard masonry work with brick or Stone for approval of the engineer before execution of the work. Stone or Bricks shall be fully representative of the range of colors and quality to be supplied for the work.

Prior to commencement of any type of masonry work the Contractor shall construct a sample panel of approximately 2500 mm × 2500 mm. In case of brick masonry, the sample panel shall be so constructed to employ the typical fair face brick in the required bond as well as soldier, header and the different cut brick courses.

603 Materials

603.1 Cement

Cement shall be ordinary Portland cement as described in Section 500- Concrete work.

603.2 Sand

Sand for mortar shall be naturally occurring sand as described in Section 500- Concrete work.

603.3 Water

The water shall be as described in Section 500- Concrete work.

603.4 Bricks

Well burnt clay bricks shall conform to the requirements of **IS 1077 and IS 2180** and shall be of the best quality brick locally available as approved by the engineer. The bricks shall be free from cracks, flaws, grit and other impurities such as lime, iron and deleterious salts. All bricks shall be well burnt, sound and hard with sharp edges giving a ringing sound when struck with a mallet.

Bricks shall be of first class standard quality comforting to **IS 3583-1978** or approved by the engineer. It should be made of good earth thoroughly burnt and shall be of deep cherry red copper color, regular in shape and their edges should be sharp and square and shall omit clear ringing sound on being struck, and shall be free from chips, flows and lumps of any kind. **Sampling and testing of Stone or Bricks shall be carried out in accordance with IS 3495**

Compressive Strength Test: Compressive strength test on bricks are carried out to determine the load carrying capacity of bricks under compression with the help of compression testing machine. The bricks shall have a minimum average compressive strength of 100 kg/cm^2. Random compressive strength testing shall be done as prescribed by the engineer.

Water Absorption Test: Absorption test shall be conducted on brick to find out the amount of moisture content absorbed by brick under extreme conditions. **During this test, dry brick samples shall be weighted and then immersed fully for a period of 24 hours.** Then weight of the immersed brick shall be noted. The difference between dry and wet weights will give the amount of water absorption

Brick Type	Water Absortion
First Class Brick	: Not more than 15%
Second Class Brick	: Not more than 20%
Third Class Brick	: Not more than 25%

Efflorescence Test: Efflorescence is a whitish crystalline deposit on surface of the bricks. Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found in efflorescence. The efflorescence test of brick means subjecting the bricks to different environmental conditions to check if they are prone to efflorescence. Bricks shall not show any signs of efflorescence when dry of subsequent to soaking. If there is any white or grey color deposits, then it contains soluble salts and not useful for construction.

The standard brick sizes shall be **9 ... × 4 ... × 2 ... (230 mm × 110mm X 55mm).** The dimensions of sizes of bricks may be amended by the engineer to suit the local condition. Where bricks are to form fair face construction, they shall be individually selected for color, size, shape and quality and if required shall match bricks in existing construction. Bricks shall be inspected by the engineer who may reject any or all bricks before incorporation in the works.

Where the engineer requires bricks to be classified by their intended use in construction, bricks of each classification shall be stored separately and apart and be clearly identified as instructed. Rejected bricks shall be immediately removed from the site.

Bricks shall not be dumped on the site. Bricks shall be carefully stacked in regular layers and otherwise handled and stored at all times so as to avoid damage.

603.5 Stone

Building stone shall be hard, tough, sound and durable, hammer dressed to secure close joints so that the stones when laid will come in the close proximity. Stones shall be fairly equal in size and every stone shall be fitted to the adjacent stones. Face stone shall be comparatively larger and uniform in size and color to give a good appearance. The stone shall be well dressed or as approved by the engineer. Except where otherwise described in the contract, the length of any stone shall not exceed three time its height. The breadth on the bed shall be not less than 15 cm greater than ¾ the thickness of the wall.

603.6 Cement Mortar

Cement mortar shall be as specified in the BOQ and the materials sand, water and cement shall be as described in Clause 502 of Section 500. Volume with boxes of 0.028 m³ (1.00 cu.ft.) capacities or other approved means shall measure sand and cement. A bag of cement shall be of 50kgs. Compensation shall be made by adding additional sand to the extent required for the bulking of sand. Mixing shall be done in a hard surface or masonry platform. The whole is mixed dry turning at least three times to have uniform mix mortar. After mixing the mortar, it shall be laid gently in layers as required and as per the direction of the engineer.

Mortar shall comply IS 2250 – 1981 and designation of grade or class shall be in N/mm². For example, class MM 7.5 means cement sand mortar in the ratio 1:3 and 28 days' compressive strength minimum of 7.5 N/mm².

The materials shall be accurately measured and mixed dry on a clear platform. Water is to be added gradually and the whole mixed again until it is homogeneous and of uniform color. Mix mortar with the minimum amount of water required achieving a workable consistency. Mortar shall be prepared in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than 30 minutes shall be discarded.

604 Brick Soling Work

604.1 General

This item shall consist of the provision and placing of all materials for the construction of brick soling in foundation to the dimensions and locations shown on the Drawings of as directed by the engineer. It shall also include preparation of surface to the specified requirements.

604.2 Materials

Brick for soling shall be as described in section 603.4.

604.3 Workmanship

Foundation bed for brick soling shall be trimmed to the required level and compacted by hand or suitable mechanical equipment to a density of not less than 95% of the maximum dry density of the material as determined by the method described in BS: 1377 (4.5 kg rammer). The Contractor shall not be permitted to place the brick soling until the engineer has tested and approved the levels and compaction of the sub-grade.

Brick for soling shall be laid on edge or flat as shown on Drawings or as directed by the engineer on foundation bed prepared as above.

Soldier coursing shall be provided at all edge conditions and elsewhere shown on the drawings. After completion the brick paving shall have a true and level surface to the required slope. The finished level of the soling at any point shall be within plus or minus 10 mm of level shown on the Drawings or as directed by the engineer.

The surface of the soling shall show no depressions in excess of 5 mm when with a 3 m straightedge placed anywhere on the completed surface. The Contractor shall remove and replaced any work outside the tolerances stated above.

605 Brick Masonry Work

605.1 Soaking of Bricks

Bricks shall be soaked in water for a minimum of one hour before their use. Soaked bricks shall be taken out from the soaking tank sufficiently in advance so that the skin of bricks would be dry at the time of laying. Such soaked bricks shall be stacked on a clean place where they will not be spoiled by dirt, earth, etc.

605.2 Preparation

All loose material, dirt and set up lumps of mortar on the surface, over which the brickwork is to be laid, shall be removed by a wire brush and water jet. The base surface shall be wetted before mortar is placed.

All brick shall be thoroughly soaked in water before use till the bubbles course comes up and laid in truly horizontal and wall shall be in plumb. No broken bricks or bats shall be used unless required to form bonds.

605.3 Patterns

All brickwork of one brick (230 mm) or over shall be laid in English Bond, Soldier and header course shall be located as indicated on the Drawings or as directed by the engineer. Half or cut bricks shall not be used except where necessary to complete the required bond. Half brick walls shall be laid with stretcher bond. New coursing shall be in line with that of the existing work. Bricks which are broken, cracked, chipped, wrinkled or have irregular edges shall not be used.

The Contractor shall provide header, soldier and cut brick coursed and accurately layout and construct the special relief brickwork as shown on the Drawings or to match existing.

605.4 Laying

The brickwork shall be laid true to line, plumb, radiated or curved as required, built solid throughout. Prior to laying all bricks are to be thoroughly soaked in water until all air pockets are removed. Bricks are to be laid in a full cement mortar bed and when bonding, the brickwork is to be set back every course. The mortar joints shall be approximately 10 mm thick with a tolerance of (±) 2 mm and broken vertically. All exposed brick faces shall have the joints raked out to a depth 15 mm to receive plaster.

Special care must be taken to maintain true, horizontal mortar joints with uniform thickness. Mortar joints shall not exceed 10 mm (3/8") in thickness and joints shall be fully filled with mortar. Bricks shall be laid with frogs upward except in the top course. All joints should be raked and faces of walls cleaned once on each working day.

All walls are to be built up in a uniform manner with level courses and kept strictly in line. No one portion of the work shall be built up more than 14 courses in one day nor more than 14 courses above the general constructions level where uneven settlement may occur.

Where the masonry of one part must be delayed, the work shall be racked back at 45 degrees according to the bond, and not toothed.

605.5 Built -In Items

Where holes are required to be left in brickwork to accommodate other work, they shall be of the minimum size according to the coursing. When pipes or other installations are fixed, the hole shall be filled with class MM 7.5 cement sand mortar and face bricks cut and neatly laid around the pipe or fixture. Steel or iron fixtures are to be entirely covered in not less than 10 mm of class MM 7.5 cement mortar. All excess mortar is to be neatly and carefully removed from all exposed surfaces. All fixtures, pipes, outlets, holdfasts or other items to be built into the brickwork shall be embedded in mortar or cement concrete in their correct position as the work proceeds. The Contractor shall construct all brickwork in full cooperation with other trades of work.

605.6 Protection and Curing

Masonry work shall be protected from rain and other adverse weather condition by suitable covering when the mortar is green. Completed work shall be protected from mortar droppings or other damage from work under way by suitable non-staining coverings. Masonry work shall be kept constantly moist on all faces for a minimum period of seven days. The masonry curing period shall commence two days after laying and shall continue for at least seven days thereafter, unless otherwise specified. Care must take to protect brick edges during and after construction.

606 Brick Projection for Butta Plaster

Bricks shall be projected 2-3 inches in cement sand mortar of (1:6) for the application butta plaster around doors, windows, cornices, sill and lintel as shown in the drawings or as instructed by the engineer.

607 Stone Masonry Work

607.1 Scope

This Section covers furnishing of materials and construction of different types of stone masonry works in accordance with the Drawing and this Specification or as directed by the engineer.

607.2 Materials

All requirements in respect of stones and cement sand mortar described herein shall be applicable in all Clauses of this Section, if otherwise not specified.

a) Stone

Building stone shall be hard, tough, sound and durable, hammer dressed to secure close joints so that the stones when laid will come in the close proximity. Stones shall be fairly equal in size and every stone shall be fitted to the adjacent stones. Face stone shall be comparatively larger and uniform in size and color to give a good appearance. The stone shall be well dressed or as approved by the engineer. Except where otherwise described in the contract, the length of any stone shall not exceed three time its height. The breadth on the bed shall be not less than 15 cm greater than ¾ the thickness of the wall.

b) Mortar

Cement mortar shall be as specified in the BOQ and the materials sand, water and cement shall be as described in Clause 502 of Section 500. Volume with boxes of 0.028 m^3 (1.00 cu.ft.) capacities or other approved means shall measure sand and cement. A bag of cement shall be of 50kgs. Compensation shall be made by adding additional sand to the extent required for the bulking of sand. Mixing shall be done in a hard surface or masonry platform. The whole is mixed dry turning at least three times to have uniform mix mortar. After mixing the mortar, it shall be laid gently in layers as required and as per the direction of the engineer.

Mortar shall comply IS 2250 – 1981 and designation of grade or class shall be in N/mm^2. For example, class MM 7.5 means cement sand mortar in the ratio 1:6 and 28 days' compressive strength minimum of 7.5 N/mm^2.

The materials shall be accurately measured and mixed dry on a clear platform. Water is to be added gradually and the whole mixed again until it is homogeneous and of uniform color. Mix mortar with the minimum amount of water required achieving a workable consistency. Mortar shall be prepared in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than 30 minutes shall be discarded.

607.3 Construction

The method of construction described herein shall hold good in all Clauses of this Section, wherever applicable.

a) General

Construction shall be carried out in accordance with I.S. 1597-1992, Code of Practice for construction of stone masonry, Part 1 Rubble stone masonry or Part 2 Ashlar Masonry as appropriate. All stratified stone possessing bedding planes shall be laid with its natural bed as nearly as possible at right angles to the direction of load. In the case of arch rings, the natural bed shall be radial. Face work groins shall be built to a height not exceeding one meter in advance of the main body of the work and adjacent walling stepped down on either side. Masonry face work between the groins shall then be built to a height not exceeding 500 mm above the backing which shall then be brought up level with the completed face work. At no time shall the backing be built up higher than the face work.

Except for dry rubble walling, all joints (gaps) shall be sufficiently thick to prevent stone to stone contact and the gaps shall be completely filled with mortar. Stones shall be clean and sufficiently wetted before laying to prevent absorption of water from mortar.

Placing loose mortar on the course and pouring water upon it to fill the gaps in stones shall not be allowed. Mortar shall be fluid, mixed thoroughly and then poured in the joints. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all its faces completely covered with mortar of the thickness as specified for joints.

The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately after placement and solidly embedded in mortar before it has set. Clean and wet chips and spalls shall be wedged into the mortar joints and bed whenever necessary to avoid thick joints or bed of mortar. When the foundation masonry is laid directly on rock, the bedding face of the stones of the first course shall be dressed to fit into rock snugly when pressed down in the mortar bedding

over the rock. For masonry works over rock, a leveling course of M15/40 or M15/20 concrete 100mm thickness shall be laid over rock and then stone masonry work shall be laid without foundation concrete block.

In case, any stone already set in mortar is disturbed or the joints broken, it shall be taken out without disturbing the adjoining stones and joints. Dry mortar and stones thoroughly cleaned from the joints and the stones shall be reset in fresh mortar. Sliding one stone on top of another which is freshly laid, shall not be allowed.

Shaping and dressing of stone shall be done before it is laid in the work. Dressing and hammering of the laid stones which will loosen the masonry, shall not be allowed.

Building up face wall tied with occasional through stones and filling up the middle with stones spalls and chips or dry packing shall not be allowed. Vertical joints shall be staggered. Distance between the nearer vertical joints of upper layer and lower layer in coursed rubble masonry shall not be less than half the height of the course.

Masonry in a structure between two expansion joints shall be carried up nearly at one uniform level throughout but when breaks are unavoidable the masonry shall be raked in sufficiently long steps to facilitate jointing of old and new work. The stepping of raking shall not be more than 45 degrees with the horizontal.

Masonry shall not be laid when the air temperature in the shade is less than 3°C. Newly laid masonry shall be protected from the harmful effects of weather.

b) Concrete Capping

Where masonry structures are to receive a concrete capping, the joints to the upper surface of the masonry shall be raked out to a depth of 10 mm prior to placing of the concrete to the capping. The concrete for capping shall be as per the Drawing or as directed by the engineer and shall conform to Section 500.

c) Pointing

Where external faces of the mortared masonry work will be backfilled or otherwise permanently covered up, the mortared joint shall be finished flush to the faces of the adjacent stonework.

Where mortared masonry faces will remain exposed, the mortar joints shall be pointed to a consistent style as shown on the Drawing. Pointing shall be carried out using mortar 1:1 by volume of cement and sand or as shown on the Drawing. The mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing, if not otherwise mentioned, shall be ruled type for which it shall, while masonry work is still green, be ruled along the centre with half round tools of such width as may be specified by the engineer. The excess mortar shall then be taken off from the edges of the lines and shall not be unnecessarily plastered over the exposed stone works. The thickness of the joints shall not be less than 3mm for Ashlar masonry.

However, the maximum thickness of joints in different works shall be as follows:

Random Rubble	:	20mm
Coursed Rubble	:	15mm
Ashlar Masonry	:	5mm

d) Ashlar

All stones shall be dressed to accurate planes on the beds and joints and they shall be fair and neatly or fine tooled on the face unless otherwise described in the contract.

e) Block-In-Course

Beds and joints shall be squared and dressed for a distance of at least 220 mm from the exposed face. Bond stones shall form at least one sixth of the area of the exposed face and shall extend at least 900 mm into the wall or for the full thickness of the wall if the latter is less than 900 mm. Unless described in the contract as tooled or drafted, the exposed face of all stones shall be blocked and left rough. Arises shall be dressed square at all beds and joints.

f) Square Rubble-Coursed or Broken Courses

All stones shall be truly squared and dressed for a distance at least 120 mm from the face of the wall. Bond stones shall be provided at the rate of at least one to every 0.8 m^2 of exposed face and shall measure not less than 150 mm x 150 mm on the face and not less than 450 mm in length or the full thickness of the wall, whichever is the less. Vertical joints in any layer shall be broken in the next layer and the horizontal lapping of the stones shall not be less than 100 mm.

g) Random Rubble - Coursed or Uncoursed

All stones shall be carefully set with a bond stone provided at the rate of at least one to every 0.9 m^2 of exposed face. Bond stones shall measure not less than 150 mm x 150 mm on the exposed face and not less than 450 mm in length or the full thickness of the wall, whichever is the less.

607.4 Test and Standard of Acceptance

Before laying any mortar, the Contractor shall make three sets of mortar test cubes from each source of sand to demonstrate the compliance of the mix to the specified strength. Each set shall comprise two cubes, one to be tested at 7 days and the other to be tested at 28 days. During construction, the Contractor shall make and test mortar cubes at the rate of three cubes for every 10 m^3 of masonry to assess the strength subject to a minimum of 3 cubes samples for a day work. Testing of cubes shall be in accordance with IS 2250. The stones shall be tested for the water absorption as per IS: 1124 and it shall not be more than 5 percent. The stones shall also be tested for Specific gravity and it shall not be less than 2.65. Sand shall be tested as per Clause 613 or as directed by the engineer. At least 3 set of tests for stone and sand shall be conducted for every source.

About one square meter (1mx1m) measured in front face of the completed stone masonry in every 200 sq.m or part of it shall be dismantled during the process of construction up to complete depth and the aggregate volume of the stones having volume more than 0.01m^3 shall be obtained by the method of displacement of water to find the volume of spalls and mortars in the case of mortared masonry and the volume of spalls and voids in the case of dry masonry. The dismantling shall be made in such a manner that the quality of the surrounding work is least affected. While dismantling, the tightness of the joints shall also be compared with the thickness of joints as specified for assessment of the quality of work. If the volume of spalls and mortars is more than the specified volume and/or the joints are not filled completely with mortar, then the entire work which the sample and test represent, shall be rejected.

The dismantled portion shall be made good by the Contractor at his own cost after completion of the test.

608 Stone Soling Work

608.1 General

This item shall consist of the provision and placing of all materials for the construction of stone soling in foundation to the dimensions and locations shown on the Drawings of as directed by the engineer. It shall also include preparation of surface to the specified requirements.

608.2 Materials

Stone for soling shall be as described in section 603.5.

608.3 Workmanship

Foundation bed for stone soling shall be trimmed to the required level and compacted by hand or suitable mechanical equipment to a density of not less than 95% of the maximum dry density of the material as

determined by the method described in BS: 1377 (4.5 kg rammer). The Contractor shall not be permitted to place the stone soling until the engineer has tested and approved the levels and compaction of the sub-grade.

Stone for soling shall be laid on edge or flat as shown on Drawings or as directed by the engineer on foundation bed prepared as above.

Soldier coursing shall be provided at all edge conditions and elsewhere shown on the drawings. After completion the stone paving shall have a true and level surface to the required slope. The finished level of the soling at any point shall be within plus or minus 10 mm of level shown on the Drawings or as directed by the engineer.

The surface of the soling shall show no depressions in excess of 5 mm when with a 3 m straightedge placed anywhere on the completed surface. The Contractor shall remove and replaced any work outside the tolerances stated above.

609 Protection and Curing

Masonry work shall be protected from rain and other adverse weather condition by suitable covering when the mortar is green. Completed work shall be protected from mortar droppings or other damage from work under way by suitable non-staining coverings. Masonry work shall be kept constantly moist on all faces for a minimum period of seven days. The masonry curing period shall commence two days after laying and shall continue for at least seven days thereafter, unless otherwise specified. Care must take to protect edges during and after construction.

610 Curing

All the cement masonry works shall be kept wet by covering with wet gunny bags for 4 hours and then cured flooding with water for the least 10 days.

611 Scaffolding and Measurement

Necessary and sufficiently strong scaffolding shall be provided to withstand all loads likely to come upon them. All masonry works shall be measured in cubic meter (m^3) and the rate shall be for the complete work including scaffolding, all tools and plants as specified in the Bill of Quantities. No Extra payments will be made for scaffolding works.

612 Measurement for Payments

Measurement for quantity of Masonry work, stone soling will be measured in cubic meters (m^3) and pointing, brick soling work shall be measured in square meter (m^2) as specified in accordance with the specifications and accepted by the engineer or as mentioned in the unit item of the Bill of Quantities.

613 Basis of Payment

Payment will be made at the contract unit rate of Masonry work, stone soling will be measured in cubic meters (m^3) and pointing, brick soling work shall be measured in square meter (m^2) as mentioned in the contract unit rate. This price shall be full compensation for supply of materials, transport, equipment tools, scaffolding, curing, labor and incidentals required to complete the respective work as specified.

614 Compressed Stabilized Earthen Block (CSEB)

614.1 Scope

This specification lays down requirements for materials, classification, general quality, dimensions, production procedure and physical requirements of Compressed Stabilized Earthen Block used in green School Building in Nepal.

614.2 References

1. I.S. 3495: 1992 Methods of tests of burnt clay building bricks
2. I.S. 5454: 1978 Methods for sampling of clay building bricks
3. I.S. 383: 1970 Specification for Course and Fine aggregates from natural Sources for Concrete
4. I.S. 12269: 1987 Specification for 53 Grade Ordinary Portland cement

614.3 Terminology

Compressed Stabilized Earthen Block (CSEB): CSEB, is a type of manufactured construction material formed in a mechanical press (Aurum 3000) that forms a compressed block out of an appropriate mix of fairly dry inorganic soil, non-expansive clay, aggregate, and sometimes a small amount of cement or lime as stabilizer. Sedimentation Test: It is a simplified test carried out in the field to identify the tentative proportion of different ingredient of soil by using a transparent cylindrical bottle of at least one-liter capacity.

Aurum 3000: Aurum 3000 machine is hand press machines. The machine consists of a frame, an interchangeable mould, a reverse toggle lever. Other accessories include scoops and bottom plates. The machine is mounted on the ground and secured in position using sand bags or stones. Measured quantity of this mixture is poured in the die of predefined shape and dimensions and is compressed by pulling the lever by hand. Then the compressed block is ejected from the die. The wet compressed blocks are stacked in rows.

614.4 Materials

Soil: Soil is the main ingredient of the CSEB. Soil characteristics and climatic conditions of an area shall be evaluated before manufacturing soil building blocks. The soil shall be much more sandy than clayey. Top soil and organic soils shall not be used. The soil, however, shall contain a minimum quantity of silt and clay so as to facilitate cohesion. The proportion of gravel, sand, silt, and clay shall be determined through Sedimentation Test or sieve analysis. Further accuracy requires sieve analysis and hydrometric test. All soils are not suitable for every building need particularly CSEB. Good soil for CSEB shall contain the following proportion of the four components: gravel, sand, silt and clay. The ingredients shall be mixed thoroughly.

Table 1: Composition of Good Soil for CSEB

Gravel	Sand	Silt	Clay
15%	50 %	15%	20 %

Water: Water is one of the important elements in CSEB production. The quality and quantity of water has much effect on the strength of CSEB. Water for mixing and curing work shall not be salty or blackish and shall be clean drinking water, reasonably and free from objectionable quantities of silt and traces of oils, acid and injurious alkali, salts, organic matter and other deleterious material which will weaken the concrete. The pH value of water shall not be less than 6. Water shall be obtained from the sources approved by the Engineer. Sources of water shall be maintained at such a depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass or other foreign materials. Containers for transport, storage and handling of water shall be clean.

Sand: Sand for use shall be natural sand. Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay, soft or flaky particles, shale, salts, organic matter, loam, mica or other deleterious substances and shall be approved by the Engineer. When the quality of fine aggregate is doubtful, it shall be tested for clay, organic impurities and other deleterious substances as laid down in I.S.383-1970.

Cement: Cement shall conform to I.S. 12269-1987. Ordinary Portland cement of grade 53 shall be used. Cement required for use shall be as fresh as possible and stored in such a manner as to prevent deterioration by dampness or moist atmosphere or intrusion of foreign matter. Any cement which has deteriorated cracked or which has been damaged shall not be used. When the quality of cement is doubtful, it shall be tested as laid down in I.S. 12269-1987. The weight of Ordinary Portland Cement shall be taken as 1440 kg. per cu.m. The measurement of proportion of cement should normally be on the bases of weight and each whole bag, undisturbed and sealed, weigh 50 kg.

Soil stabilizer: The chemical admixtures such as lime, cement, and/or fly ash shall be used as a mean of chemically transforming unstable soils into structurally sound construction foundation. The selection of a stabilizer will depend upon the soil quality and the project requirements. Cement will be preferable for sandy soils and to achieve quickly a higher strength. Lime will be rather used for very clayey soil, but will take a longer time to harden and to give strong blocks.

Table 2: Composition of Good Soil for CSEB for different stabilizer

Soil for cement stabilization: it is more sandy than clayey	Gravel 15%	Sand 50%	Silt 15%	Clay 20%
Soil for lime stabilization: it is more clayey than sandy	Gravel 15%	Sand 30%	Silt 20%	Clay 35%

Table 3: Suitability of stabilizers and their percentage

Stabilizer	Suitability	Min'm %	Avg. %	Max'm %
Cement	Mostly for sandy soil	5%	7%	No technical maximum Economic Max'm: 9 - 10 %
Lime	Mostly for clayey soil	5%	8%	10%

614.5 Classification

The CSEB shall be classified on the basis of average compressive strength and water absorption.

Table 4: Classes of CSEB

	Class A	Class B
Dry Compressive Strength (Mpa)	5-7	2-5
Wet Compressive Strength (Mpa)	2-3	1-2
Water Absorption(% by weight)	5-10	10-20

614.6 General Quality

CSEB shall be molded from good soil (with gravel-15%, sand-50%, silt-15% and clay -20%). CSEB shall be of uniform, regular in shape and size and shall have shapes having each two adjacent plane surfaces at true right angles.
CSEB shall be free from cracks, chips, flaws, stones or lumps of any kind. They shall be free from salt, which affect the mortar of the masonry. CSEB shall not show any sign either of efflorescence dry or subsequent to soaking in water. CSEB shall be sound, hard, homogeneous texture.

614.7 Dimension and Tolerances

The standard size of CSEB made out of Aurum 3000 shall be are as follows:

Table 5: Dimensions of CSEB

Types	Length (mm)	Breadth (mm)	Height (mm)
Plain full block	240	240	90
U block	240	240	90
Special blocks			
Half block single insert	240	120	90
Full block single insert	240	240	90
Full block double insert	240	240	90

Tolerances shall be specified in accordance with relevant Code of Practices or and as directed and approved by the Supervisor/Engineer

614.8 CSEB Production Procedure

Material Selection and Collection: The basic materials required for the production of compressed stabilized earth building blocks are soil, stabilizer, and water. Soils are found naturally but all soils are not suitable for CSEB Production. Some visual inspection and simple testing shall carry to select material sources. Top soil shall be removed as it contains organic matters. Soil below the top soil shall be collected in large quantity as per required and transferred to the site. Collection of soil can be done manually or with the help of excavator and tractor.

Pulverizing and Screening: The materials' lumps shall pulverize in order to disintegrate manually or mechanically. Soil then shall screen in order to remove large size materials and also to get the soil of uniform size which helps for well mixing with sand and cement. Generally screening can be done with 10mm size mesh wire net but done with 2mm size mesh wire net for better performance while mixing.

Testing: Laboratory analysis of the raw material is always necessary for large-scale production of compressed stabilized earth blocks. For small-scale production, however, it is not essential to employ sophisticated tests to establish the suitability of a soil. Simple field tests such as visual identification smell test, touch test, sedimentation test, adhesion test, washing test, Dry strength test, water retention test, consistency test, and cohesion test shall be performed to identify the composition and quality of the soil sample. Among many tests, Sedimentation test shall be at least done to identify different composition of soil. Further accuracy requires sieve analysis and hydrometric test.

Proportioning: Before starting production, tests shall perform to establish the right proportion of soil, stabilizer and water for the production of good quality blocks. The proportions of these materials and water shall then use throughout the production process. To ensure uniformity in the compressed stabilized earth blocks produced, the weight or volume of each material used in the block making process shall measure at the same physical state for subsequent batches of blocks. The volume of soil or stabilizer shall ideally measure in dry or slightly damp conditions. After establishing the exact proportion required of each material, it is advisable to build a measuring device for each material. The dimensions of each measuring box shall be such that their content, when full, is equivalent to the proportion which should be mixed with other materials measured in other boxes.

Mixing: In order to produce good quality blocks, it is very important that mixing be as thorough as possible. Dry materials shall be mixed first until they are of uniform color, then water is added and mixing

continued until a homogeneous mix is obtained. Mixing can be performed by hand on a hard surface, with spades, hoes, or shovels.

Water shall add a little at a time, sprinkled over the top of the mix from a watering can with a rose spray on the nozzle. The wet mix shall turn over many times with a spade. A little more water may then be added, and the whole mixture turned over again. This process shall repeat until all the water has been mixed in. Machine can use for mixing. It should have paddles or blades that move separately from the container. A concrete mixer shall not use for mixing the wet soil, since the latter will tend to stick on the sides of the rotating drum. Hand-mixing methods are often more satisfactory, more efficient and cheaper than mechanical mixing, and are less likely to produce small balls of soil that are troublesome at the block moulding stage.

Moulding: Special precautions shall be taken during moulding in order to produce blocks of uniform size and shall be well compacted to achieve dense and compressed blocks. A machine, Aurum 3000, can be used for the production of CSEB which can produce 1000 blocks per day. The internal faces of the machine mould shall be moisten with a mould releasing agent (reject oil) in order to get well shaped and neat surfaced blocks.

Transporting and storing and curing CSEB: The produced CSEB should be properly carried to the site for storing and curing. Proper handling shall be done during transportation. The site selected for storing shall be well leveled ground and protected from direct exposed to hot dry weather conditions which prevent block shrinkage and warping. It is done till the CSEB production completes. The curing should be done with portable water for a period of three weeks to achieve its maximum strength.

614.9 Laying

The CSEB shall be laid true to line, plumb, radiated or curved as required, built solid throughout. Prior to laying all bricks are to be thoroughly soaked in water until all air pockets are removed. CSEBs are to be laid in a full cement mortar bed and when bonding, the brickwork is to be set back every course. The mortar joints shall be approximately 10 mm thick with a tolerance of (±) 2 mm and broken vertically. All exposed blocks faces shall have the joints raked out to a depth 15 mm to receive plaster. The mortar shall be of ratio as specified in the Bill of Quantities (BOQ).

Special care must be taken to maintain true, horizontal mortar joints with uniform thickness. Mortar joints shall not exceed 10 mm (3/8") in thickness and joints shall be fully filled with mortar. All joints should be raked and faces of walls cleaned once on each working day.

All walls are to be built up in a uniform manner with level courses and kept strictly in line. No one portion of the work shall be built up more than 14 courses in one day nor more than 14 courses above the general constructions level where uneven settlement may occur.

Where the masonry of one part must be delayed, the work shall be racked back at 45 degrees according to the bond, and not toothed.

614.10 Physical Requirements

Some physical requirements shall be as given in table 6.

BASIC DATA ON CSEB

PROPERTIES	SYMBOL	UNIT	CLASS A	CLASS B
28 day dry compressive strength (+20% after 1 year)	σ_d	Mpa	5 -7	2 - 5
28 day wet compressive strength (after 24 hours immersion)	σ_w	Mpa	2 - 3	1 - 2
28 day dry tensile strength (on a core)	τ	Mpa	1 - 2	0.5 - 1
28 day dry bending strength	β	Mpa	1 - 2	0.5 - 1
28 day dry shear strength	S	Mpa	1 - 2	0.5 - 1

Poisson's ratio	μ	-	0.15 - 0.35	0.35 - 0.50
Young's Modulus	E	Mpa	700 - 1000	-
Apparent bulk density	γ	Kg/m3	1900-2200	1700-2000
Coefficient of thermal expansion	-	mm/m°C	0.010-0.015	-
Swell after saturation (24 hours immersion)	-	mm/m	0.5 - 1	1 - 2
Shrinkage (due to natural air drying)	-	mm/m	0.2 - 1	1 - 2
Permeability		mm/sec	1.10-5	-
Total water absorption	-	% weight	5 - 10	10 - 20
Specific heat	C	KJ/Kg	~ 0.85	0.65 - 0.85
Coefficient of conductivity	λ	W/m°C	0.46 – 0.81	0.81 – 0.93
Damping coefficient	m	%	5 - 10	10 - 30
Lag time (for 40 cm thick wall)	d	h	10 - 12	5 - 10
Coefficient of acoustic attenuation (for 40 cm thick wall at 500 Hz)	-	dB	50	40
Fire resistance *	-	-	Good	Average
Flammability *	-	-	Poor	Average

Dry Compressive strength: The block when tested in accordance with the procedure laid down in IS 3495 (Part 3): 1992 shall have 28 days' dry compressive strength of various classes as given in Table 4.

Wet Compressive strength: The blocks when tested in accordance with the procedure laid down in IS 3495 (Part 3): 1992 shall have 28 days' dry compressive strength of various classes as given in Table 4.

Water absorption: The blocks when tested in accordance with the procedure laid down in IS 3495 (Part 2): 1992 shall have water absorption of various classes as given in Table 4.

Efflorescence: The blocks when tested in accordance with the procedure laid down in IS 3495 (Part 3): 1992, the rating of efflorescence shall not be more than 'moderate' as specified in code.

614.11 Physical Requirements

Sampling and Testing of blocks shall be done in accordance with procedure describe in IS 5454:1978 and IS 3495: 1992.

614.12 Measurement for payments

Measurement for quantity of Masonry work using CSEB will be measured in cubic meters (m^3) and pointing, Plaster work shall be measured in square meter (m^2) as specified in the unit item of the Bill of Quantities (BOQ) or in accordance with this specification and accepted by the engineer.

614.13 Basis of payments

Payment will be made at the contract unit rate of Masonry work and will be measured in cubic meters (m^3) and pointing, plaster work shall be measured in square meter (m^2) as mentioned in the contract unit rate. This price shall be full compensation for supply of materials, transport, equipment tools, scaffolding, curing, labor and incidentals required to complete the respective work as specified.

PART 700 DOORS AND WINDOWS

701 General

This section of specification covers furnishing of all labor, materials, hardware, services and equipment necessary for the supply and installation of aluminum doors and windows as shown in the drawings.

All services shall comprise labor, equipment and the supply of the appurtenant materials and structural components including transport, loading, off-loading and storage at the Site, unless otherwise specified.

Clauses which specify materials of special make are binding but in addition, the Contractor may at its discretion offer similar and equivalent products of other make in alternative items submitted by him with the Tender.

In general, all materials, fixtures and fittings shall be of first class manufacture and trade quality and they shall be subject to the approval by the engineer.

Any specifications not mentioned hereunder but stipulated under other Section of works shall also be applicable for this chapter.

702 Related Work

All work under this Section shall be properly coordinated with the work of other Sections/Sections of the specification.

703 Submittals

The following submittals are required prior to start of the works:

703.1 Product Data

Submit detailed technical information for each type of door shutter and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes. The Contractor shall also submit the manufacturer certification that materials meet the Specification requirements.

703.2 Shop Drawings

The Contractor shall submit the scaled shop drawings showing fabrication and installation of frames and shutter of all the doors and windows. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of shutter and frame hardware and reinforcements, method of glazing, details of operating hardware and details of joints and connections. Show anchorage and accessory items.

703.3 Door Schedule

Submit schedule of doors and windows using same reference numbers for details and openings as those on the Drawings. Indicate coordination of glazing frames and stops with glass and glazing requirements.

703.4 Mock-up

Provide full scale complete mock-up for each type of door including shutter, all required accessories and fixtures to demonstrate, method of works, aesthetic and qualities of materials and execution.

Advice engineer with 24-hour notice that mock-ups are ready for inspection.

Once approved, mock-ups will be the material and workmanship standard for this contract. Approved mock-ups installed locations may become part of the permanent work.

703.5 Reports and Certificates

For door assembly required to be fire rated, submit certified test reports from an independent testing laboratory of fire ratings for door assemblies.

704 Delivery, Storage and Handling

The frames and shutters of doors and windows shall be wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished door and frames.

Inspect doors and frames for damage upon delivery. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the engineer; otherwise, remove and replace damaged items as directed.

Store frames and shutters at building site under cover. All materials shall be delivered in manufacturer's original, unopened, undamaged packages or containers with manufacturer's label intact.

705 Quality Assurance

705.1 Manufacturer

Provide products of manufacturer **with no less than 5 years' experience** in manufacturing the door/window shutter and frames and accessories for the required work. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.

Provide a complete door/window shutter and required accessories from single manufacturer specializing in the production of this type of work.

705.2 Installer

All installation works shall be carried out with the installer experienced to perform work of this section who has specialized in the installation of work similar to that required for this project.

706 Wooden Doors and Windows Frames

706.1 Material

Generally, the timber for carpentry and joinery shall be Sal wood (Nepali Agrakh) of the best quality obtained from an approved saw mill. The timber shall be reasonably straight grained. All timber shall be seasoned, matured, and free from wraps, knots holes and other defects and are to be open stacked. All timber as it arrives on the site shall be inspected by the engineer, and any unapproved timber at the must be removed forthwith. All timber of assembled woodwork shall be protected from the weather and stored in such a way as to prevent attack by termites, insects or decay fungi conforming **as per IS:2202** standard approved.

The minimum compressive strength of the timber shall be 70 kg/cm².

All timber shall be free from live barer beetle or other insect attack when brought upon the site. The contractor shall be responsible up to the end of the maintenance period for executing at his own cost all work necessary to eradicate insect attack of timber which becomes evident, including the replacement of timber attached or suspected of being attacked, not withstanding that the timber concerned may have already been inspected and passed as fit use before.

All timber shall be seasoned to moisture content of not more than **22% for frames and 15% for shutter**. The contractor's price must include for any kiln drying that may be necessary to achieve these figures.

The timber used must be first class kiln seasoned and preservative treated Sal wood, to shape and profile as shown in the drawings with mitred joints including necessary MS hold fasts (20 x 6 mm) 300 mm long,

3 nos at each side, and concrete (1:2:4) block grouting for fixing the holdfast and anchor fasteners/ coach screws. Frames must be erected in absolute plumb and level as per design, drawings and instructions of the site engineer all complete.

706.2 Construction Procedures

706.2.1 Clearing Up

The contractor is to clear out and destroy or remove all cut and shavings and other wood waste from all parts of the building and the site generally, as the work progress and at the conclusion of the work.

706.2.2 Carpentry

All carpentry shall be executed with workmanship of the best quality. Scantling and boarding shall be accurately sawn and shall be of uniform width and thickness throughout. All carpenter's work shall be left with sawn surface except where particularly specified to be wrought.

All carpenter's work shall be accurately set out in strict accordance with the drawings and shall be framed together and securely fixed in best possible manner with properly made joints. All necessary brads, sheet metal screws, etc. shall be provided as directed and approved.

706.2.3 Joinery

All joints shall be accurately set out on boards to full size for the information and guidance of the artisans before commencing the respective works, with all joints, iron work and other works connected therewith fully delineated. Such setting out must be submitted to Engineer and approved before such respective works are commenced.

All jointer's work shall be cut out and framed together as soon after the commencement of the building as is practicable, but is not to be wedged up or glued until the building is ready for fixing same. Any portions that warp, wind or develop shakes or other defects within six months after completion of the works shall be removed and new fixed in their place on contractor's own expense.

All work shall be properly mortises, tenons, house, shouldered, dovetailed, notched, wedged, pinned, braided, etc., as directed and to the satisfaction of the consultants and all properly glued up with the best quality approved glue.

Joints in joinery must be as specified or detailed, and so designed and secured as to resist or compensate for any stresses to which they may be subjected. All nails, springs, etc. are to be punched and puttied. Loose joints are to be made where provision must be made for shrinkage, glued joints where shrinkage need not be considered and where sealed joints are required. Glue for load-bearing joints or where conditions may be damp must be damp must be of the resin type. For non-load-bearing joints or conditions may be guaranteed casein or organic glues may be used. All exposed surfaces of joinery work shall be wrought and all arise "eased-off" by plaining and sand papering to an approved finish suitable to the specified treatment.

706.2.4 Dimensions

Joinery shall hold up to the specified sizes and as measure.

706.2.5 Fixing Joinery

All beads, fillets and small members shall be fixed with round or oval brads on nails well punched in and stopped. All large members shall be fixed with brass screws, the heads let in and palette to match the grain.

Unless otherwise specified, plugs of external work shall be of hardwood; plugs for internal work may be of softwood. Holes for plugging must be made with a proper drilling tool and the holes completely filled with the plugging material.

Unless otherwise specified all skirting, window, grounds and backings for same, fillets etc., shall be plugged at intervals not exceeding 600mm.

706.2.6 Bedding Joinery

All door and window frames, sills, wooden bars etc., which are fixed to brickwork, concrete by means of grounds, lugs, etc., shall be bedded solid in mortar as previously described and pointed with a recessed joint 6mm deep to the approval of Engineer.

Plywood, Block boards, Chipboards and MDF board, shall be bonded with synthetic resin of "interior" type and sheet metal screws unless otherwise stated for the doors. Where stated to be "exterior" type, they shall be weatherproof.

All exposed edges of block board and chipboard shall be lipped with hardwood as described below.

Samples of all such materials and their source of manufacture must be approved by Engineer before used in the works.

706.3 Inspection and Testing

Engineer shall be given facilities for inspection of all works in progress whether in workshop or on site. All timber as it arrives on the site and not approved by them must be removed forthwith, failing which the Employer, with the advice of Engineer, may arrange for the removal of the rejects and impose of them as they may consider advisable at the contractor's expenses.

Notwithstanding approval having been given as above, any timber incorporated in the works found to be in any way defective before the expiry of the maintenance period shall be removed and renewed at the contractor's expense. The contractor is to allow for testing or prototypes of special construction units and Engineer shall be at liberty to select any samples they may require for the purpose of testing i.e. for moisture content, or identification of species, strength, etc.

Where timbers need to be extended into a wall, they shall be thoroughly "Brush Treated" with a wood preservative approved by Engineer, and as much clear air space maintained around the timber where it adjoins the wall as possible.

706.4 Measurement

Measurement of works will be made in m^3 of works as specified.

706.5 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transportation, labor, equipment, accessories and to complete the works as specified.

707 Wooden Door Panel and Window Shutters

707.1 Material

Timber shall conform as in **Clause 706.1.**

Agrakh Panel Shutter Doors Works:

The thickness of Panel Door of Nepali Agrakh shall be 38mm including hardware (100x75) mm hinges using 3 nos on each side, Mortice lock along with cylinder, 600mm T.length Handle, Door Closer, tower bolts etc. with all necessary accessories and with proper finished chapra polish minimum 3 coats as per design & drawing all complete.

707.2 Hardware

a) Paneled Door and Flush Door Shutter Hardware

Nails, hinges, mortice lock, handle, door closer, door stopper, tower bolt etc.

b) Paneled Window Shutter Hardware

Nails, hinges, handle, door closer, door stopper, tower bolt etc.

707.3 Construction Procedure

The door/window shutters may be fully paneled, fully glazed, partly glazed and partly paneled, battened or Venetian as specified. Styles and panels shall be neatly planed and truly finished to exact dimensions. Styles and rails shall be framed properly and accurately with mortise and tenon joints and fixed with bamboo pins as per drawing. Glue shall be applied at all joints before clamping and fixing with bamboo pins. Panels shall be of one piece without any joints.

The construction procedure shall confirm as in **Clause 706.2.**

707.4 Testing and Inspection

The Testing and Inspection shall conform as in Clause 706.3.

707.5 Measurement

Measurement of works will be made in m^2 of works as specified.

707.6 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, hardware (hinges, tower bolts, handles, locks, door closer etc.), glass, accessories and equipment to complete the works as specified.

708 Wooden Flush Door (Single/Double Leaf)

708.1 Material

The wooden flush door shall be single or double leaf having the size of 40 mm thickness comprising the standard of IS: 2202 certification along with all the hardware fittings

708.2 Construction Procedure

The fabrication of the individual door shutters shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. Fabricated door shutter shall be rigid, neat in appearance, and free from defects, warp, or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.

Door shutters shall be hung by skilled workers to fit snug against stops. Fit accurately and hang free from hinge bind with uniform clearance of 2 mm at heads and jambs. After hanging, make adjustments, and then remove doors and hardware for finish painting and make final adjustments. Verify that direction of swing is as indicated.

Door hardware shall be installed accurately and securely without marking or defacing hardware or finish work. Hardware shall be fastened with machine screws or bolts. Sheet metal screws will not be permitted. Hardware shall be tested to assure correct alignment and operation. Finished hardware shall be fastened at all points where fasters are indicated or required.

Thresholds shall be embedded in approved sealant, and shall be secured to concrete floors with stainless steel screws in nonferrous expansion shields.

Weather stripping and seals shall be installed to provide rainproof service and so that there is no air, light and sound leakage. Stops shall fit tight against doors.

Provide protective facings or coverings for shutters and frames to receive continued use during construction, such protective coverings shall be removed immediately before final inspection.

708.3 Measurement

Measurement of works will be made in m^2 of works as specified.

708.4 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, hardware (hinges, tower bolts, handles, mortice locks, door closer etc.), glass, accessories and equipment to complete the works as specified.

HELVETAS NEPAL

800 METAL WORKS

801 Structural Steel Works

801.1 Scope of Works

a. General

The work to be executed by the Contractor under this section shall comprise of all structural steel support structures, frames, beam, column, mezzanine floors, MS sheet, MS pipes, nut and bolts and two coats of red oxide to all steel structure surface of buildings. All work shall be constructed in accordance with the locations, dimensions, lines and grades shown on the Drawings or established by the Engineer.

b. Item of Work

a) Structural Steel work shall include the following:

- Preparation of shop/fabrication drawings.
- Procuring all material, fabricating, transporting, erecting, testing and inspection of structural steel, metal deck and all associated necessary items as shown in the Drawings.
- Shop preparation and application of anti-corrosion primer paint to structural steel.
- Incidental steel construction.
- All secondary steelworks members necessary for installation of roofing, wall cladding, fascia, doors and windows, louvers, services, etc., which are not specifically shown in the drawings or covered by the other works but required to complete the Work.

b) Field painting (touch up and zinc coating); touch up shop primer and apply second coat of primer to all members.

c. Specific Standards

The work shall be carried out in accordance with the requirements of IS 800: 2007 General Construction in Steel – Code of Practice or equivalent international standard accepted by the Engineer.

d. Submissions

Prior to commencement of the Steel works, the Contractor shall prepare and submit for the Engineer's approval:

a) All Manufacturers' catalogues detailed technical data, specifications and installation instructions for all components and items.
b) Proposals for steel fabricator including information of the factory layout, equipment, annual production, number of engineers, qualified welders and sufficient further information to enable approval by the Engineer.
c) Shop drawings for all work required indicating, in detail, the fabrication, assembly and erection requirements, material lists, length, height & elevation joint and connection details and filling details. Shop drawings indicating fabrication requirements shall be submitted not less than one (1) month before fabrication commences. In addition, the Contractor shall submit structural calculations for any work proposed which is at variance with work as shown or specified.
d) A detailed method statement indicating the proposed methods, schedule, sequences, standards, etc., to be adopted as detailed in 801.1.7 below.
e) Proposal for the specialist engineer authorized by the approved manufacturer and engineering firm to carry out the tensile fabric membrane construction.

e. Detail Drawing Development

The Contractor shall develop the detailed drawings and submit subsequently the associated shop drawings where the steel elements are shown but specific details are not shown in the Drawings. The Contractor shall submit the design analysis necessary for the development of such details as required under the Contract or if requested by the Engineer. The design analysis and development of the details

shall be carried out according to relevant codes and standards of Indian Standards, British Standards or other equivalent international standards accepted by the Engineer.

f. Detail Drawing Development Constraints

Unless required or permitted otherwise, comply with the following when developing the detail drawings and detailing of the work:

a) End craters to be excluded when calculating lengths of welds.
b) Bolts to be not less than 12mm diameter.
c) Not less than two bolts to be used in any connection.
d) Minimum weld throat thickness to be 6 mm.

g. Proposals for Erection

At least 28 days before starting erection of steelwork, Contractor shall submit a detailed method statement for the structural steel works including but not limited to:

a) Detailed steel works schedule to tally with overall construction programme required under the Contract
b) Comprehensive sequence and manners of erection works with drawings, sketches, etc.
c) Type and capacity of heavy equipment including all logistics.
d) Temporary, stage/platform, guys and bracing proposed for use during erection.
e) Any special hardstand requirement.

h. Structural Steel Framing

Fabrication General

a) Materials and Workmanship General

- To IS 2062: 2011 Hot Rolled Low, Medium and High Tensile Structural Steel or equivalent international standards accepted by the Engineer.
- Control accuracy of fabrication to ensure compliance with levels of accuracy specified for the erected structure.
- Inform the Engineer when fabrication is due to start. Do not fabricate steelwork for which the shop drawings have not been approved by the Engineer.
- Before fabricating, ensure that surface condition of steel which is to be coated complies with requirements specified for cleaning.
- Ensure that fabrication processes do not cause changes in properties of materials resulting in noncompliance with specified requirements.
- Connections shall be of the same grade as the parent section.
- Steelwork: yield strength of 250 MPa to IS 800: 2007 or equivalent international standards accepted by the Engineer.
- Bolts shall conform to the following requirements or of equivalent international standards accepted by the Engineer.
    - High strength bolt: grade 8.8 to IS 3757: 1983
    - Machine bolt and anchor bolt: grade 8.8 to IS 6639: 2005
    - Stud: Type B, Yield Strength 250 MPa to AWS D1.1
    - Chemical Anchor Bolt: Epoxy injection type anchor bolt with the proof load as required in the Drawing shall be proposed by the Contractor with full technical information of manufacturer for the Engineer's approval.

b) Cold-Formed Steel Purlins

Contractor shall make detailed drawings and supply of the purlin system.

c) Storage and Handling

- Store fabricated steelwork clear of the ground and keep clean.
- Handle and store carefully to avoid damage to steelwork and any protective coatings.

- Identification marks to be visible when members are stacked.

d) Marking

- Submit details of proposed methods of identifying and recording materials and components to ensure correct use and location in the structure.
- Marks to be placed in positions which can be checked after erection.
- Marking of weathering steel to be on surfaces which will not be exposed to view in the completed work.
- Marking of steel which is to be shot blasted, pickled, metal sprayed or galvanized to be by an approved method which cannot be obliterated.

e) Straightening and Flattening

Do not hammer. Heating to not more than 650°C may be used. Do not use accelerated cooling without approval.

f) Faying Surfaces for High Strength Bolt Joint

Check faying surfaces in steel 25mm thick or more for deformities such as bowing, twist or rippling which may reduce slip factor to below design limit. Agree remedial measures with the Engineer. The faying surfaces, which are in accordance with IS 4000: 1992 Sub-clause 6.4 or equivalent international standard approved by the Engineer, may be considered as having a slip factor of 0.45. The surfaces which have been machined or given any form of treatment shall have a slip factor determined by tests to IS 4000: 1992 Annex B or accepted equivalent international standards.

g) Compression Joints

Abutting surfaces dependent on contact for transmission of load to be milled, sawn or otherwise suitably prepared to ensure full and even distribution of load.

h) End Connections

Ensure that angle cleats, if used, project beyond ends of simply supported members.

i) Hollow Sections

Ensure that insides of sections are dry and clear of debris, before sealing ends and openings.

j) Base Plates

Make 22 mm diameter holes in all base plates more than $1m^2$ in area to allow the escape of air when grouting after erection of columns.

k) Finishing

- Remove burrs and sharp edges by grinding.
- Carefully dress welds to remove slag by light hammering, wire brushing or other methods that do not deform the surface of the weld.

l) Shop Assembly

Main roof trusses shall be shop assembled to confirm fitness, profile, dimensions and camber. Before delivery to the site the Contractor shall conduct a factory inspection in the presence of the Engineer.

m) Welding

i. Welding General

Welds shall be sufficient, adequate and suitable to perform the structural requirements, and subject to approval by the Engineer. All welding for steel work shall conform to the IS 816-1969 Code of practice for use of metal arc welding for general construction in mild steel and IS 9595: 1996 Metal-Arc welding of carbon and carbon manganese steels - recommendations, BS 5135 or equivalent international standard as accepted by the Engineer. Stud shall be welded with automatically timed stud welding equipment unless otherwise manual welding procedures has been accepted by the Engineer.

ii. Welder

Welding shall be performed by the pre-qualified welders to approved welding procedures to IS 7310 (Part 1): 1974 Approval tests for welding procedures fusion welding of steel and/or IS 7307 (Part 1): 1974 Approval test for welding procedures fusion welding of steel as required, BS EN 287-1 or equivalent international standards accepted by the Engineer, and the welders shall be exclusively assigned for the welding work for the Project with regard to type, position of welds. All welders shall be identified and recorded to each weld. If any welder is observed not performing satisfactorily, such welder shall be removed from the work as instructed by the Engineer.

iii. Welding on Site

Welding on site shall be performed in accordance with the approved method statement and welding procedures and only by the approved welders exclusively assigned for site welding work for the Project.

iv. Additional Welds

Do not place any welds (including tack welds) not shown on drawings, without approval, even for temporary attachment or repair of faulty plates.

v. Butt Welds

Use run-on and run-off plates/end tab to ensure full throat thickness at ends of butt welds as follows:

- Material for plates to be of same grade as material being welded.
- Prepare plates in same manner as parts being joined.
- After completion of welding, remove plates, if requested by the Engineer, by cutting and grind smooth the surfaces where they were attached.
- Retain and identify plates for inspection.

vi. Bolt Assemblies

a. Bolts General

- All high strength bolts to be in compliance with IS 3757: 1985 and IS 4000: 1992 or equivalent international standard as accepted by the Engineer.
- Bolt length shall be such that one thread plus the thread run out will be clear between the unit and the unthreaded shank of the bolt after tightening and at least one clear thread shall show above the nut.
- All nuts and bolts to be grade 8.8 to IS 6639: 2005 or equivalent international standard accepted by the Engineer.

b. Using Drift Pins

- Align holes carefully to prevent distortion or enlargement when using drift pins.
- Report any misalignment of holes to the Engineer. If a faulty member is not rejected, ream hole only for minor correction.

c. Tapered Washers

The use of tapered washers is allowed in accordance with IS 800: 2007 General Construction in Steel – Code of Practice or equivalent international standard as accepted by the Engineer.

d. Load Indicating Bolts or Nuts

Load indicating bolts or nuts may be used in accordance with IS 4000: 1992 High strength bolts in steel structures – code of practice where applicable, after submission of manufacturer's information for the Engineer's approval.

e. Sealed Hollow Sections

Bolt holes/holes on hollow section shall be sealed to prevent ingress of moisture with the method approved by the Engineer.

f. Erection

i. General

- Erect, install and secure work per shop drawings as approved.
- Not less than fifteen (15) days before the proposed start date for commencement of erection work, check foundations and other structures to which steelwork will be attached for accuracy of setting out, and holding down bolts for position, protruding length, condition and slackness.
- Report any inaccuracies and defects to the Engineer without delay.
- Obtain permission of the Engineer to commence erection.
- Correctly locate, properly position and securely anchor all items and assemblies for full bearing of members upon supporting structural elements.
- Erection and bracing operations and procedures shall not damage work previously placed nor overstress building elements or components.
- Damage caused by operations herein during erection shall be repaired as directed by the Engineer at the cost of contractors' expense.

ii. Erecting Steelwork

- Provide all temporary erection bracing, support and/or platforms which are necessary to ensure stability of the building during erection.
- Remove such temporary bracing, support and/or platforms when it is safe to do so and steelwork has been completely connected and stable, at the timing to be agreed following the approval of the Engineer.
- Do not distort steelwork and do not exceed stress limits during erection unless otherwise approved.
- Position and fix anchor bolts in each required location utilizing setting plates for respective locations as follow: Setting plate/anchor frame details shall be developed in the working drawings by the Contractor and submitted for the Engineer's approval.
  - Hook ends: Positioned and in symmetrical arrangements as shown.
  - Threaded ends: Unless otherwise shown in the Drawings, projecting above supporting construction sufficient to provide not less than 10mm projection above top of double anchor nuts when base or bearing plates are set and secured.
- Set and water-level setting plates to elevations required by utilizing levelling nuts; each plate bearing fully on all levelling nuts, and each temporarily secured into place utilizing anchor nuts turned thumb tight only, but firmly holding the plate. Solidly fill under each setting using an approved type of non-shrink dry packed grout (Minimum strength of grout shall be fcu=50N/mm2), well-cured and of sufficient strength attained before bearing loads are applied to setting plates. Shimming in lieu of levelling nuts and/or grouting as required herein will not be permitted.

iii. Tolerance

Tolerances for fabrication and erection of steel structures shall conform to IS 7215:1974 Tolerances for fabrication of steel structures and IS 12843: 1989 Tolerances for erection of steel structures respectively or equivalent international standards accepted by the Engineer.

iv. Modifications

- Inform the Engineer of any defects due to detailing or fabrication errors.
- Obtain approval of methods of rectification before starting modification or remedial work.

g. Inspection/Testing of Steelwork

i. Inspection

- In the course of quality assurance and quality control procedures, the Contractor shall carry out his own inspection by the qualified engineer and/or inspector having a certificate for the purpose of the inspection. Notwithstanding, the Contractor shall propose for the Engineer's approval an independent inspection agency to carry out various inspections required under the Contract. Permit the Engineer, and/or the approved independent inspection agency to inspect the work at all reasonable times and at all places where it is being carried out. Provide all facilities, hand tools, lighting, etc. as necessary to ensure adequate inspection.
- Inspection at each welding phase shall be conducted as follows:
  - Before Execution of Welding: Scum, angle of bevel, root clearance, cleaning of welding surface, quality of end tab, drying of welding rod.
  - During Execution of Welding: Welding procedure, diameter of core and wire, type of flux, welding current and voltage, welding speed welding rod position, length of arc, melting, cleaning of slug of each level under surface chapping, direction of welding rod shall require prior approval of the Engineer.

ii. Testing

The Contractor shall propose for the Engineer's approval an independent testing laboratory to carry out various tests required under the Contract. All specified testing of constituent materials to be carried out by the approved independent testing laboratory.

- Welds shall be tested by means of non-destructive testing methods, either ultrasonic test, magnetic particle test, dye penetrant test or visual inspection ' ultrasonic test.
- Other than the above, 30 % of remaining full penetration welds shall be examined by ultra sonic test. After all or part of completed welds have been done, the Contactor shall identify such welds subject to inspection for the Engineer to select at random the welds for examination.
- If ten (10) percent of the random ultrasonic test indicates unacceptable defects the remaining seventy (70) percent shall be tested.
- 30 % of fillet welds, flare welds and/or welds to tubular steel, shall be examined with dye penetrant test or magnetic particle test.
- All examinations shall be performed by qualified inspector(s) from the approved independent testing agent. Unacceptable defects found shall be recorded properly and subject to repair. All repairs shall be re-examined to acceptance.

iii. Products

When requested by the Engineer, submit two copies of test certificates for steel.

iv. Defective Work

As soon as possible after any part of the work or any materials are known or suspected to be defective, document proper records and submit proposals to the Engineer for further testing, inspection or replacement and obtain instructions.

h. General Requirements for Protective Coating Work

i. Protective Coating

All the structural steelwork shall be applied with a corrosion protective coating as specified herein.

ii. Operatives

Operatives must be appropriately skilled and experienced in the use of specified materials and methods of application.

iii. Coating Materials

- Coating materials shall be of a single manufacturer and approved by the Engineer, wherever possible, to be from one manufacturing batch. Where more than one batch is to be used, keep separate, allocate to distinct parts or areas of the work, and inform the Engineer accordingly.
- Check that all coating materials to be used are recommended by their manufacturers for the particular surface and conditions of exposure, and that they are compatible with each other.
- Coating materials shall be obtained from only one manufacturer unless specified otherwise.

iv. Preparation Materials and Ancillaries

All tools, goods, materials, preparation of surface for application of coating, etc., shall be as recommended by the manufacturer.

v. Inspection

- Permit coating manufacturers to inspect the work in progress and take samples of their products if required. Do not comply with any directions or requests given by the coating manufacturer's representative unless and until confirmed by the Engineer.
- Notify the Engineer of projected dates for inspection on surface preparation and coating.
- Give the Engineer at least 7day notice before shipping of coated members or components from the manufacturers premises.

vi. Handling and Storing Coated Steelwork

- Use methods and equipment which will minimize chafing, chipping and other damage to coated components.
- Ensure an adequate drying/curing period for each coat before handling.
- Use suitable packing, lashings, lifting harnesses, nylon slings, rubber protected chains and chocks, etc.
- Stack coated components clear of the ground, separated by timber chocks, and so that bond does not occur.

vii. Protection

- Adequately protect freshly applied surface coatings from damage.
- Exhibit 'Wet paint' signs and provide protective barriers where necessary.
- Adequately protect surfaces adjacent to those being covered.

viii. Remedial Work

- Early degradation of coatings by blistering, peeling, flaking, cracking, lack of adhesion, etc. must be made good by complete removal, preparation and reapplication of all coats, as instructed.
- Inadequate dry film thickness or surface defects due to inclement weather may, depending on the type of paint, be remedied by rubbing down and applying further coat(s), as instructed.
- Mechanical damage to coatings must be made good by local cutting back of coatings, preparation and reapplication of all coats to leave a neat, continuous and flat finish.
- Where damage to coatings or subsequent surface preparation has exposed bare metal, it must be thoroughly cleaned and primed within two hours.

i. Protective Coating System(s)

i. Micaceous Iron Oxide (MIO) Paint

- Use/location: All Internal Steelwork.
- Shop preparation: Blast clean to BS 7079 Part A1: 1989
- Shop primer: a dry film thickness of 40 microns
- Second coat: a dry film thickness of 50 microns
- Application method: Airless spray, Touch up: Brush

ii. Preparation for Painting

iii. Offsite Preparation and Painting

Offsite preparation and painting to be carried out under cover in properly lit, heated and ventilated conditions. Select sequence of working from one of the following and inform the Engineer before starting work:

- Fabricate – blast clean – prime as specified
- Blast clean – fabricate – prime as specified (Immediately before priming remove flash rust with a light overall sweep blast), or
- Blast clean – prime with a weldable prefabrication primer recommended by the manufacturer of the specified primer – fabricate – prime as specified.

iv. Inaccessible Surfaces

The sequence of working must be such as to ensure that surfaces inaccessible after assembly receive the full specified treatment and coating system including, if necessary, local shop application of site coatings.

v. Blast Cleaning for Painting

- Ensure that steel complies with British Standard BS4232 at time of blasting as follows:
  - Dry blasting: Initial rust grade A or B.
  - Wet blasting: Initial rust grade A, B or C.
- Thoroughly degrease. Remove mill scale by chipping, grinding and/or heat treatment.
- Blast clean to the specified BS 4232 quality, and control quality of preparation in accordance with BS 5493, Appendix F. Use chilled iron abrasives to BS 2451, grades G17 or S170, free from contamination by dust, water and oil.
- Remove all surface defects likely to be detrimental to the protective painting system, including:
  - Defects in the steel, including cracks, surface laminations, shelling and deep pitting as required by BS 4360.
  - Defects resulting from fabrication, including fins at cuts, burrs, sharp edges and weld spatter.
  - Rogue peaks remaining after blasting.
- Thoroughly clean off all dust in a clean area of the works using a vacuum head fitted with edge brushes.
- Apply primer as soon as practicable and within four hours of blasting.

vi. Manual Cleaning of New Steelwork

- Ensure that steel complies with British Standard BS4232 initial rust grade C at time of cleaning.
- Chip, scrape, disc sand and grind surfaces to remove all fins, burrs, sharp edges, weld spatter, loose rust and loose scale. Clean out all crevices.
- Thoroughly degrease using emulsion cleaners followed by thorough rinsing with water.
- Apply primer when surface is dry and on the same day as cleaning.

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vii. Preparation for Site Welding of Shop Painted Steelwork

- Blast clean and mask weld areas before coating surrounding areas. If more than one coat is applied to surrounding areas, step each 30 mm back from edge of preceding coat. Remove masking immediately before welding.
- Alternatively prepare and shop paint weld areas as specified, then grind off to bare steel immediately before welding.

viii. Treatment of Site Welded Joints in Painted Steelwork

- After welding, and without delay, remove all scale and weld spatter from the weld areas by grinding or chipping, abrade to remove all traces of rust, wash with clean water and allow to dry.
- Prime without delay and apply further coatings to the weld areas to match the surrounding painted areas.

ix. Bolted Joints (Non-Friction Grip)

- Where steelwork is to be shop painted, ensure that the full shop specification is applied to joint faces.
- Where steelwork is to be erected with a mill finish then site painted, prepare and prime joint faces before erection and allow to dry.
- Immediately before assembling bolted joints in externally exposed steelwork, apply a further coat of primer and bring the surfaces together while still wet.
- Before applying site coatings to externally exposed steelwork, seal all crevices to bolts and joint perimeters with a compatible mastic.

x. Faying Surfaces of Friction Grip Joints

- Blast clean and mask before coating surrounding areas. The masking must adequately protect the faying surface from deterioration and contamination.
- If more than one coat is applied to surrounding areas, step each 30 mm back from edge of preceding coat.
- Remove masking immediately before bolting, check faying surfaces are free from adhesive and clean with solvent if necessary.

xi. Friction Grip Joints in Shop Painted Steelwork

- After final tightening of bolts, and without delay, thoroughly degrease and clean bare steel at joint edges and prime as specified.
- Seal all crevices to bolts and joint perimeters with a compatible mastic.
- Apply further coatings to surrounding areas to match adjacent shop painted areas before applying specified site coatings.

xii. Uncoated Fastenings

After erection, thoroughly degrease, clean and without delay, apply coating(s) to match surrounding shop painted areas before applying specified site coating(s).

xiii. Site Painting of Shop Painted Steelwork

- Prepare all damaged surfaces by abrading and/or washing down as instructed by Engineer.
- Apply touch up primer to all prepared areas after erection.
- Apply one further coat of micaceous iron oxide paint to entire surface area of steel work after erection; no extra payment shall be made for this work.

j. Painting

i. Suitability of Conditions

- Do not apply coatings:
  - To surfaces affected by moisture.
  - When the relative humidity is more than 80%.
  - When heat is likely to cause blistering or wrinkling.

- Take all necessary precautions including restrictions on working hours, providing temporary protection and allowing extra drying time, to ensure that coatings are not adversely affected by climatic conditions before, during and after application.
- Application of coatings shall be undertaken only after confirmation of the suitability of surfaces and conditions within any given area in accordance with the specification/instructions of the paint manufacturer and the approved method statement. The Contractor shall assign a skilled person for all corrosion protective painting works and the application of coating shall be commenced at such person's sole decision and after the acceptance of the Engineer.

ii. Applying Coatings

- Multiple coats of the same primer coat material must be of a different tint to ensure that each coat has complete coverage.
- Apply coatings to clean, dust free, suitably dry surfaces in dry atmospheric conditions and after any previous coats have hardened.
- Apply coatings evenly to give a smooth finish of uniform thickness and colour, free from brush marks, nibs, sags, runs and other defects.
- Keep all surfaces clean and free from dust during coating and drying. Adequately protect completed work from damage.

iii. Film Thickness

- Wet film thickness of each coat to be not less than that required to give the specified dry film thickness. Before starting work prepare and measure test samples to verify the relationship between wet and dry film thickness and submit results to the Engineer.
- Check the thickness of each coat during application using a wet film thickness wheel or comb in accordance with BS 3900: Part C5.
- After each coat has dried, measure the total accumulated dry film thickness using a magnetic or electromagnetic meter, checked against standard shims and re-calibrated regularly as recommended by the manufacturer, the number and position of measurements to be as directed by the Engineer. Carry out all measurements in the presence of the Engineer unless otherwise directed.
- Over any square meter of coating the average accumulated dry film thickness must be equal or exceed the specified thickness, with no reading less than 90 % of the specified thickness.
- If at any stage the accumulated dry film thickness is deficient, the Engineer may require the application of additional coat(s) at no extra cost. The full top coat thickness must be maintained, notwithstanding any greater than specified undercoat thickness.

iv. Stripe Coats

Brush apply an additional narrow stripe coat of the same nominal thickness as the relevant full coat to all external angles. Stripe coats of primer must be applied after the general coat.

v. Junctions with Concrete

Where exposed steelwork is partially embedded or encased in concrete, apply two coats of an approved rubber/bituminous coating locally to the steel/concrete junction as instructed by the Engineer.

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801.2 Measurement and Rates

a. Measurement

- The quantity shall be computed from the Drawings and measurement and payment shall only be against the pay items contained in the Structural Steelworks Section of the Bill of Quantities.
- Structural steel to be measured in kilograms (kg). The quantity shall be computed from the net dimensions of the components indicated on the Drawings, multiplied by the appropriate nominal unit weights indicated thereon or derived from standard approved weight tables. No deduction shall be made from the quantity for splay cuts, curved cuts, holes or notches. No allowance shall be made in the quantity computation for the weight of bolts or welds.
- Paint for Steel Structure shall be measured in kilograms (kg). The quantity shall be the same as that of the steelworks structures requiring painting.
- No extra payment shall be claimed by the contractor for nut and bolts used in the structural steel works.
- No extra payment shall be claimed by the contractor for the two coats of red oxide paint used in the structural steel works.

b. Rates

- The rates shall be full compensation for all Plant, materials, labour, equipment, transport, Temporary Works, establishment charges, installation, testing, commissioning overheads and profit required to complete the work described in the Specification.
- Rates for structural steel work shall be deemed to include for:
  - Temporary bracing and supports
  - Cutting, drilling, notching, bevelling, grinding and all other labours.
  - Rolling margins
  - All necessary steel shims, wedges and packing and non-shrink grout under all base plates and fixings
  - All necessary welding (fabrication or erection)
  - Checking and adjusting level of structural supporting elements
  - All delivery, unloading, hoisting and erection
  - All necessary concrete pad stones
  - All nut bolts, anchor bolts, fixing, bolts, turnbuckles, base plates, and all other fixings
  - Protection
- Rates for corrosion protective painting to structural steel surfaces shall be deemed to include for:
  - Preparation of surfaces
  - Application of corrosion protective shop primer
  - Touching up primer coat after erection of steelworks
  - Subsequent coats of corrosion protective paint system applied after erection of steelworks
  - Protection to finished surfaces

802 Mild Steel Grating

802.1 Material

The Mild steel gratings are fabricated from the Mild Steel flat, angle and channels conforming to the BS 15 or equivalent. The welding shall be butt-welding. The screws shall be steel screws.

The Mild Steel Gratings of section as per designed drawing shall be fitted with necessary accessories and at least two coats of red oxide paint should be applied before implementation.

802.2 Construction Procedures

The mild steel grill shall be made according to pattern given as per drawing. Welded joints shall be neatly made, filled smooth and left clean, the consultant is to be informed when the welded work is ready for inspection and any such work must be left unprimed until the consultants gives his approval. The contractor shall furnish at his own expenses all necessary tools and all materials, which he may require for the safe erection of the work and remove the same when the work is completed. The contractor shall be solely responsible for any damage done to the structure during erection and any member, which has been bent or otherwise distorted either before or during erection, shall be straightened or replaced in an

approved manner at his own expenses. The grating work shall be finished with two coats of red lead followed by three coats of aluminum or enamel paint and fixed in the opening, as per instructions of the consultants.

The gratings are fixed to drain opening by steel screws firmly to the faces of drain.

802.3 Testing and Inspection

The erected fencing shall deform any post and wires shall be straight without sagging.

802.4 Measurement

The above work shall be measured in m^2 of opening in vertical plan completed as specified.

802.5 Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

803 Mild Steel Railing

803.1 Material

The mild steel railing are fabricated from the Mild Steel Hollow Section of different sizes in Horizontal and vertical. Welded joints shall be neatly made, filled smooth and left clean, the consultant is to be informed when the welded work is ready for inspection and any such work must be left unprimed until the consultants gives his approval. The contractor shall furnish at his own expenses all necessary tools and all materials, which he may require for the safe erection of the work and remove the same when the work is completed.
The railing work shall be finished with two coats of red oxide coating and finishing coating will be with 2 coats of enamel paint as per approved color by the consultant.

803.2 Testing and Inspection

The erected handrails, balustrade, railing and grab bar shall be straight without sagging.

803.3 Measurement

The above work shall be measured in weight (Kg) as specified.

803.4 Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ. No extra charge is applicable for the primer painting work.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

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PART 900 CEMENT PLASTERING & PUNNING WORKS

901 Scope

This Section covers furnishing of materials and construction of different grades of plaster works in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

Plastering shall be made up of mortar consisting of cement, sand in the different proportion as indicated in the BOQ as specified in the drawing.

902 Material

Cement shall be fresh and free from impurities and as specified in clause 502, river bed sand shall be used. Sand for plastering shall be finer than the sand used for concreting or brick work. Following shall be proportion of different size of grains.

Grain		Percent
0 to 0.5 mm	=	30%
0.5 to 2 mm	=	50%
2 to 3 mm	=	20%

Water shall be clean and free from pollution by soil particles, humus, mud, dirt, natural or vegetable oil, soap and other impurities.

903 Construction Procedures

The surface to be plastered shall be brushed clean mortar joints of brick masonry walls or any other surface to be plastered shall be raked to a depth of approximately 12mm, and the surface brushed down with a stiff brush and thoroughly wetted. The surface shall be free of all dust, loose materials, grease etc.

The mortar shall be first dry mixed, by measuring with boxes to required proportion, and then water added slowly and gradually and mixed thoroughly to uniform consistency.

The thickness of the plaster shall not be less than 12.5 mm. In case of plaster thicker than 20 mm, it shall be built by two or more coats each coat not exceeding 12.5 mm in thickness.

Cement shall be as specified **in section 500.**

Sand shall be as specified in section 500 but shall be graded to a suitable fineness in accordance with the nature of the plaster, etc., in order to obtain the finish required.

All other mixes shall be constructed in a like manner.

Moist curing shall be accomplished by keeping the plaster uniformly damp by suitable means. Moist curing shall start during application and continue for not less than 7 days.

903.1 Hacking

Prices of all paving and plastering etc. shall include for hacking concrete ceilings, beams, floors etc., by approved means and for raking out joints of walls 12 mm deep to form a proper key. Plastering on walls generally shall be taken to include flush faces of lintels etc., in same.

Surfaces to be paved or plastered must be brushed clean and well wetted before each coat is applied. All cement plaster shall be kept continually damp in the interval between application of coats and for seven days after application of the final coat.

Dubbing out where required shall be composed of similar material to that following.

Partially or wholly set material will not be allowed to be used or re-mixed.

903.2 Samples

The Contractor shall prepare sample square meter of the plastering and paving as directed until the quality, texture and finish required is obtained and approved by the engineer after which all plastering or paving executed shall conform with the respective approved sample. No payment shall be accounted for such sampling.

903.3 Finish

Care shall be taken to ensure that finished plaster surfaces shall be plumb, square, straight and true to line.

Generally, all screeds and paving shall be finished smooth, even and truly level (unless specifically required to falls and currents, etc.), and paving shall be steel troweled or floated.

Rendering and plastering shall be finished plumb, square, smooth and even.

All surfaces to be plastered shall be thoroughly wetted before any plastering is commenced and the Contractor shall allow in his prices for dusting external angles with neat cement to give additional strength.

No plastering will be allowed to take place until all chases for service have been cut, services installed and chases made good. On no account may finished plaster surface be chased and made good.

All Work shall be to approval and any not complying with the above shall be hacked away and replaced, as directed, and at the Contractor's expense.

903.4 Arises and Angles in Plastering

All arises shall be clean and sharp or slightly rounded as directed including neatly forming miters.

All making good shall be cut out to a rectangular shape, the edges undercut to form dovetail key and finished flush with face of surrounding plaster. All cracks, blisters and other defects must be cut out made good and the whole of the paving and plastering Work left perfect on completion.

Screeds shall be in cement and sand (1:4 or 1:3) and rates shall include for thoroughly hacking, cleaning and soaking the receiving structure in water. No screed shall be laid on a dry structure in any circumstances.

Where changes of floor finish occur they shall be divided by strips as specified.

The Contractor's special attention is drawn to the fact that all screeds, immediately after the initial set has taken place, will be required to be continuously covered in water by the sand trap or other approved method for at least 10 days. Any screed panel that is found to be dry before the end of this period shall be removed at the discretion of the engineer.

Waterproofed external rendering shall consist of minimum 12mm cement and sand (1:4 or 1:3) rendering at the rate of 2.05 liter to 41 kgs of cement all in accordance with the manufacturer's instructions and finished perfectly true and even with a wood float.

903.5 External and Internal Plastering

Waterproofed External Plaster or Rendering work shall consist of minimum 12.5 mm as detailed in the Bill of Quantity with cement/ sand ratio 1:4 at the rate of 1/2 gallon to 90 lbs of cement. The plaster work shall be done in two layers: the first layer of the plaster shall be 6 mm thick this surface shall be roughened by scraping using trowel after applying the first layer the plaster shall be cured as instructed by the engineer, the second layer of plaster shall be 6.5 mm thick this surface shall be smooth and finished perfectly true and even with a wood float and curing shall be done in the second layer as instructed by the engineer. The external plaster shall be in perfect line and level.

903.6 Ceiling Plastering

Internal Plastering or Rendering shall consist of minimum 12.5 mm as detailed in the Bill of Quantity with cement/ sand ratio 1:3 at the rate of 1/2 gallon to 90 lbs. of cement. The plaster work shall be done in two layers: the first layer of the plaster shall be 6 mm thick this surface shall be roughened by scraping using trowel after applying the first layer the plaster shall be cured as instructed by the engineer, the second layer of plaster shall be 6 mm thick this surface shall be smooth and finished perfectly true and even with a wood float and curing shall be done in the second layer as instructed by the engineer.

904 Punning and Pointing Works

904.1 Materials

The materials required for punning and pointing works are cement, sand and water and shall be in accordance with the requirements of **clause 502.**

904.2 Construction Procedures

Before applying the punning and pointing, the base surface shall be cleaned, any dust or loose particles removed and thoroughly wetted. The surface shall be free of all dust, loose materials, grease etc. The average thickness of the punning and pointing work shall not be less than 3 mm. The pattern shall be as per instruction of the engineer or as shown in the drawings.

The mortar shall be first dry mixed, by measuring with boxes to required proportion, and then water added slowly and gradually and mixed thoroughly to uniform consistency.

The coat shall be finished by rubbing with a steel trowel and any depression shall be filled in and rubbed to shining surface.

Cement shall be as specified in **section 500**.

Sand shall be as specified in **section 500** but shall be graded to a suitable fineness in accordance with the nature of the plaster, etc., in order to obtain the finish required.

All other mixes shall be constructed in a like manner.

Moist curing shall be accomplished by keeping the plaster uniformly damp by suitable means. Moist curing shall start during application and continue for not less than 7 days.

905 Measurement

Measurement of works will be made in m^2 of works as specified.

906 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transport, labor, equipment, scaffolding and incidentals required to complete the respective work as specified.

907 Wall Care Putty (White Cement Putty) for External and Internal Wall

905.1 Scope of Work

Wall care putty consists of white cement, high quality polymers and specialty chemicals and mineral fillers and is formulated to make it suitable to apply even on damp surfaces. Being cement based putty; it has better compatibility with the base plaster and forms a durable base for paints. It can be applied on both, Interior and exterior plastered surfaces. It is a water resistant base coating to the plastered surfaces to provide fine leveling and a protective base for the surfaces to be painted.

905.2 General

Wall care putty shall have superior water resisting properties to prevent paint from flaking even if the walls are damp. It should fill-up fine pores in walls and ceilings to get the smooth and dry surface for painting. Wall care putty shall have better properties in terms of water-resistance, adhesive strength and durability as compared to the ordinary putties. The putty shall provide a breathable surface and allow any trapped moisture to move out keeping the wall dry and clean.

It also resists the growth of Algae, has excellent Abrasion Resistance with controlled Water Vapour Permeability which does not require Curing with Water.

905.3 Material

Wall care Putty shall be in dry free flowing powder form. Required quantity of Wall care putty shall be procured from the reputed manufacturers or approved manufacturers, or from their authorized dealers.

The putty shall be procured in the form of Fine Matt finish as specified in the description of the item.

905.4 Preparation of Surface

- Surface should be clean of loose particles, dirt, grease and traces of foreign material. Sand papering or chipping shall be done if so required.
- Loose plastered areas/defective materials shall be removed & surface re-plastered and cracks filled-up properly.
- Uneven ceiling/wall surfaces shall be made even by re-plastering. This will add smooth and uniform finish to rough plasters.
- Surface should be pre-wetted prior to application. This helps in providing a strong bond with substrate.
- Since water curing is not required, it has good water resistance. It also has good Tensile Adhesion Strength, Compressive Strength and Flexural Strength.

905.5 Mixing

- 16 to 20 liters (40-50% by volume) of clean water shall be required for a bag of 40 kg of wall care putty. Required quantity of putty (which is required to be used at a time) shall be added to the water in right proportion considering pot life of thinned material as 2.5- 3.5 hrs. (Temp. 30 +/- 2 Degree Celsius, 5RH 65 +/- 5).
- Mix shall be stirred continuously by using an electric mixer or by hand to obtain a homogeneous lump-free paste.
- The paste shall be allowed to stand for about 10 minutes for the additives to dissolve.
- The paste shall be re-mixed again for about 2 minutes.
- This mix should be used within 2.5- 3.5 hrs. (Temp. 30 +/- 2 Degree Celsius, 5RH 65 +/- 5).
- Dry the wall to recoat for 6-8 hrs. (Temp. 30 +/- 2 Degree Celcius, % RH 65 +/-5)

905.6 Application

- The plastered surface shall be dampened with clean water and excess water shall be allowed to be drained off.
- Using a steel trowel/blade, the above mix shall be applied to a thickness of about 1 – 2 mm. Then the surface shall be leveled and smoothened. This first coat shall be cured lightly after it dries-up.
- Then second coat shall be applied after first coat is fully dried and set. Second coat shall be cured lightly for two days.
- Over plastered / coarse putty substrate, fine wall care putty of about 1 to 2 mm thickness shall be applied, to smoothen the surface with a steel trowel. Finished surface of wall care putty shall not require any dressing by Emery Paper but if at all it is done, the paper should not be less than 500 number.

- Coverage of wall care putty depends upon surface quality. However, approximate coverage for fine wall care putty shall be 20-25 sq. ft./kg. (Average coverage may vary from the quoted figures due to factors such as method of application, environmental conditions and surface texture.

Application	Product	Code	Thinner	Dilution % (By Volume)	Recoating Period
Step 1	Sand the Surface with Sand Paper and Wipe Clean				
Step 2	Pre Wet the Surface Before Application of 1st Coat of Wall Putty				
Step 3	For Interior Wall Putty: First Coat Wall Putty (Knife/Trowel)	5440	Water	40%-50%	6-8 Hrs
Step 4	For Interior Wall Putty: Second Coat Wall Putty (Knife/Trowel)	5440	Water	40%-50%	6-8 Hrs
Step 5	Apply a coat of Primer Followed by 2-3 coats of Emulsion				

Recoat period is quoted for 25 degrees Celsius and 50% Relative Humidity, these may vary under different conditions

905.7 Recommended Usage:

Wall putty can be applied on all types of Interior cement plasters, interior ceilings, asbestos sheets, concrete etc.

905.8 Safety and Environment Features:

- The bag should be stored in sealed conditions away from moisture source.
- Keep out of reach of children and away from eatables.
- It may be harmful if swallowed. In case of ingestion, seek immediate medical attention.
- Wear Eye Protection during application. In case of contact with eyes, rinse immediately with plenty of clean water and seek medical attention.
- Do not breathe vapor or spray. It is recommended to wear mask during sanding and surface preparation to avoid dust inhalation.
- Do not pour leftover down the drain or in water courses.
- In the event of spills, contain spillage using sand or earth and dispose through authorized agency for waste management.
- Left-over paints/pails/drum/sacs should not be disposed in soil/drains. Consumer should consult a local recycling agency for disposal of paints/pails/drums/sacs.
- The paints/pails/drums/sacs should not be used for storing food items.

908 Measurement

Prices of wall care putty shall include for preparation of surfaces, rubbing down between each coat, stopping, knotting, etc., and all other Work in connection as described and as necessary to obtain a first class and proper finish. Price must include for the provision of all necessary transportation, material, scaffolding, plant and tools, labor and incidentals to complete the work as specified.

Measurement of all the painting works will be made in m^2 of works as specified.

909 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transportation, labor, scaffolding, equipment and incidentals required to complete the respective work as specified.

1000. PAINTING WORKS

1001. General

Painting and related works shall be performed by experienced and qualified professionals, capable of applying paints and/or coating in accordance with general practice and recognized standards, the paint manufacturer's instructions and in accordance with the present specifications.

The quality of paint shall meet the stipulated requirements of the site and the specifications hereunder.

All services shall include labour, tools and equipment, and the supply of materials and building components necessary thereto, including unloading and storage on the site, if nothing contrary is stipulated in the Specifications.

All necessary precautions shall be taken by the Contractor to protect personnel and property from hazards due to falls, toxic fumes, explosion or other harmful effects.

All painting and corrosion protection work, including that on the inside of buildings and vessels, shall be performed under strict safety conditions, primarily adequate ventilation and protection from open flames, sparks, direct rays of the sun, excessive heat. Areas where such work is performed shall be clearly marked with warning sign boards.

If the Contractor should desire to apply painting works to other Standards than those specified hereunder or the present specifications, it shall submit full details about preparation, type of materials, methods and sequences it proposes to use to comply with the requirements for the protection of the structures, machinery and equipment.

With regard to materials, the Contractor shall submit for the Engineer's approval full details of the materials it proposes to use, including the source of the basic raw materials, volatile matter content, nature of solvent, number of components, type of coat, coverage, time interval between coats and number of coats, toxic properties, physical properties, shelf life, pot life, etc.

It shall describe in detail the treatment it proposes to apply in order to give adequate protection during transport, site storage, and subsequent application. Paint shall be stored separately from thinners and solvents. In paint and solvent/thinners storage areas, warning sign boards shall be set up.

In addition to the above, the Contractor shall provide adequate ventilation at all times during painting until coating and curing is completed. Suitable ventilation from at least two different sources shall be installed in order to prevent a local build-up of solvent vapours. In all cases it shall be ensured that solvent vapours are kept at least at 20% below the explosion limit.

When designing ventilation installations for above mentioned purposes, attention should be paid to the fact that solvent vapours are heavier than air.

While working under above conditions, the necessary lighting and electrical equipment shall be explosion-proof.

1002. Scope

This Section covers furnishing of materials and construction of different types of painting works in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

1003. Related Work

The Contractor shall become familiar with other Sections of the specifications and affecting works of this trade and co-ordinate all work between Sections as required.

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1004. Submittals

1004.1 Colours and Samples

The Contractor shall submit three (3) 300mm x 300mm sample of all colours in each paint item to the Engineer for approval prior to execution of work. Full product literature, including colour selection swatches shall be provided from each manufacturer the Contractor proposes to use.

1004.2 List of Materials

Not less than 30 days before beginning painting work, the Contractor shall submit a complete list, in duplicate, of all materials proposed for use, together with manufacturer's specifications. All paint and coating materials and products shall be subject to the Engineer's approval.

1004.3 Unsuitability of Specified Products

No claim by the Contractor concerning the unsuitability of any material specified or the Contractor's inability to produce first class work with same will be entertained, unless such claim is made in writing to the Engineer before the Work is started.

1004.4 Mock-up for Approval of Final Colours

Final coat of paint for both exterior and interior work shall not be applied until the colours have been approved by the Engineer. To accomplish this, the Contractor shall paint a sample panel, approximately 2 m^2, of the colours selected on every surface of the building to be painted. The Engineer shall approve the sample panels or direct changes as desired.

The Contractor shall be on the job and be prepared to change sample panels to colours desired on the spot. The Contractor shall notify the Engineer at least 5 days in advance of when the Contractor shall be ready to receive approval for the sample panels. Such notice shall not be given, however, until permanent fluorescent and incandescent lights are installed and in operation in the rooms or areas where the sample panels have been painted; temporary lights at the same level and of the same type, intensity, and colour as the permanent lights will be permitted for viewing of sample panels.

1004.5 Scaffolding

The Contractor shall furnish, maintain and remove all scaffolding, ladders and planks required for this work, and all drop cloths for the protection of concrete walls, floors, pre-finished materials, building fixtures, etc. Painted and finished surfaces subject to damage or defacement due to other work on the building shall be properly protected and covered.

The Contractor shall be responsible for any and all damage to painted work and to that of other work caused by operations under this Section.

1005. Delivery And Application of Paint

All materials shall be delivered on site intact in the original drums or tins and shall be mixed and applied strictly in accordance with the manufacturer's instructions and to the approval of the engineer. All cement paints and washable distemper shall be applied by brush; emulsion paints shall be applied by means of a brush then rolled. All enamel paints are applied by brush or sprayed, and bitumen and bituminous base aluminum paints are applied by brush. Before application of any paint, adjoining surfaces shall be covered by cloth, or paper and wherever paints stains it shall be removed before leaving the work in same day.

The only addition, which will be allowed to be made locally will be liquid thinners supplied or recommended by the manufacturers and none shall be, thinned more than approved by the engineer.

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1006. Preparation And Priming Of Surfaces

Concrete and Cement rendered surfaces shall be smooth and free from defects and shall be allowed to dry out thoroughly. Surfaces shall be thoroughly brushed down and left free from all efflorescence, dirt and dust.

All such surfaces, which are to be finished with oil or enamel paint, shall be primed with two coats of alkali resisting primer.

Plaster surfaces shall be perfectly smooth and free from defect. All such surfaces shall be allowed to dry for a minimum period of four weeks. Surfaces shall be stopped with approved plaster compound, rubbed down flush, thoroughly brushed down and left free from all efflorescence, dirt and dust.

Fair-faced surfaces shall be dry, brushed down and free from dust or dirt and shall be treated with an approved alkali resisting primer (for plastic emulsion).

Metal work generally shall be thoroughly wire brushed to remove all scale, rust, and through sand papering shall be done before any painting is done. Where severe rust exists, the special anti-rust primer must be used. After painting it shall be stored in covered shed and 60cm above ground.

Shop primed surfaces shall have bare places touched up with an approved metal primer.

Un-primed surfaces shall be given one coat of primer as last.

Galvanized surfaces, which are thoroughly weathered, shall be, brushed down with white spirit, washed down and given one coat of zinc chromate primer.

Bituminous-coated surfaces shall be given as isolating coat of shellac knotting followed by an approved metal primer.

Woodwork generally shall be rubbed down, given one coat shellac knotting, one coat wood self-knotting primer, and all cracks, nail holes, defects, and uneven surfaces, etc., stopped and faces up with hard stopping rubbed down flush.

Before oiling woodwork all stains must be removed and uniform color obtained and filled.

1007. Colors And Priming

The priming undercoats and finishing coats shall each be of differing tints and the priming and undercoats shall be of the correct types and tints to suit the respective finishing coats in accordance with the following instructions. All finishing coats shall be of colors and tints selected by the engineer. The paintwork shall have and uniform finish and all paint for external work shall be exterior quality only.

1007.1 Rubbing Down

Each coat of paint shall be properly dried and shall be well rubbed down with fine glass paper before the next coat is applied. The paintwork shall be finished smooth and free from brush marks.

Samples Cards of all paints, etc., shall be submitted to and samples prepared for approval of the engineer before laying on and such samples, when approved, shall become the standard for work.

1007.2 Program

The contractor shall so arrange his program of work that all other Trades are completed and away from the area to be painted when the painting begins.

1007.3 Ironmongery, Protection and Cleaning Up

All ironmongery shall be removed from joinery before painting is commenced and shall be cleaned and renovated of necessary and re-fixed after completion painting.

Cover up all floors, etc., with non-resinous sawdust or other approved covering when executing and all painting decorating work.

Paint splashes, spots and stains shall be removed from floors, woodwork, etc., and damaged surface touched up and the whole of the work left clean upon completion.

1007.4 Materials

All paint materials of specified brand shall be obtained the manufacturer or authorized dealer. All sealers, primers and undercoating are to be obtained from the makers of the finishing materials and are to be in accordance with their recommendation for the particular finish required.

1007.5 Knot Sealer

For use on knots and resinous portions of woodwork.

Stopping and Filling composed of parts putty to one part of stiff white lead.

1007.6 Lacquer

Approved polyurethane eggshell clear lacquer applied in accordance with the manufacturer's instructions.

- Polish shall be an approved brand of wax polish.
- Oil shall be best quality linseed oil.
- Filler for polished or oiled surfaces to be Beeswax filler.

1007.7 Wood Preservative

All wood work, as specified or instructed shall, be treated after cutting and preparation but before assembly or fixing with three coats of solution consisting of one part if Atlas "A" wood preservative brown grade to three parts of water. The solution is to the brushed in all faces of all timbers unless exposed to view and painted. This is applicable in the wood frame contact with masonry and roof purlin, batten and counter rafter.

The contractor shall note that this solution is HIGHLY POISONOUS and shall take all necessary precautions and instruct his workmen accordingly.

1007.8 Paint Application

Painting Items as described hereafter shall comprise the following, and shall all include for preparing and priming surfaces as above described: -

Cement Paint: Apply two coats.
Plastic Emulsion: Apply a minimum of two coats, using a thinning medium or water only if and as recommended by the manufacturer. An approved plaster primer tinted to match may be substituted for the first coat.

Enamel paint: Apply one primer coat and two finishing coats of enamel gloss oil paint.

Flat oil paint: Apply two coats of flat oil paint, using thinning medium in accordance with the manufacturer's instructions.

Oil: Apply two coats of linseed oil.

Wax Polish: Apply a minimum of two coats to approval.

Lacquer: Apply three coats of Polythene lacquer as described, to approval.

Prime: Prepare and prime only before fixing.

1008. Enamel Paint (Asian, Berger or Equivalent)

The enamel paint shall be of approved quality and of approved manufacture like Asian Paints, Nerolac, Jensolin Berger or equivalent brand approved by the engineer. These materials shall be ready mixed and in sealed tins with manufacturer's name, colour and instruction clearly painted in the container.

1008.1 Preparation of Surface

All surfaces to be painted shall be planed and thoroughly sand papered, first by using No. 120 sandpaper. Ordinary putting shall fill up nail holes, cracks or other in equalities. Putting shall be made up of 2 parts of best quality whiting (absolutely dead stone lime) 1 part if white lead mixed together in linseed oil and kneaded (3 oz. of linseed oil to 1 lb. of whiting). A primer coat shall be locally applied in holes, cracks etc. before putty is applied. The putty/paste fillers shall be of approved quality and manufacture and shall be applied to the surface with a knife or other sharp edged tools after the priming coat as well as after each undercoat. After the surface is dry, it shall be sand paper by using No. 60 sandpaper.

Surface so prepared shall be painted with one coat of primer. The primed surface when dry shall be sand papered by using No. 100 sand paper.

The primed surface so prepared shall be painted with one coat of selected enamel using bristle brush and not horsehair ones. The paint shall be applied in thinnest possible layers with parallel strokes.

Care shall be taken to ensure the surface being free from dust or other foreign material before priming or enameling the surface. No paint shall splash on the floor, wall jambs, sill or other part of the building.

1008.2 Application

a) On Wood Work

After preparing and after the priming coat has been applied a topcoat shall be applied. The primed surface so prepared shall be painted with one coat of selected enamel using bristle brush and not horsehair ones. The paint shall be applied in thinnest possible layers with parallel strokes. Another coat shall be applied after the previous coat is dry. Care should be taken that dust or other foreign materials do not settle or otherwise disfigure the various coats. The same brand of materials will be used for various coats. The paint shall be used and applied as per manufacture's printed instruction. The paints shall be applied with bristle brushes and not horse hair ones. The paints shall be applied in the thinnest possible layers with parallel drawings, no flowing down shall be allowed. Painting to false ceiling and acoustic materials such as thermo Cole, perforated acoustic tile, soft board etc. shall be done by spray painting only. The Engineer prior to commencement of work shall approve sample of workmanship.

b) On Metal Surface

The paint shall be continuously stirred in the container so that its consistency is kept uniform throughout.

The painting shall be laid on evenly smoothly by means of crossing and laying - off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternatively in opposite directions, 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 after the laying – off if finished. The full process of crossing and laying - off will constitute one coat. Where so stipulated, the painting shall be carried out using spray machines suited for the nature and location of the work to be carried out. Only skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding suitable thinner. Spraying shall be carried out only in dry conditions. No exterior painting shall be done in damp foggy or rainy weather. Surface to be painted shall be clean, dry, smooth, and adequately protected from dampness. Each coat shall be applied in sufficient quantity to obtain complete coverage, shall be well brushed and evenly worked out over the entire surface and into all corners, angles and crevices allowed to thoroughly dry. Second coat shall be of suitable shade to match final colour, and shall be approved by the Engineer before final coat is started.

Allow at least 48 hours drying time between coats for interior and 7 days for exterior work, and if in the judgement of the Engineer more time is required it shall be allowed.

Finished surfaces shall be protected from dampness and dust until completely dry. Finished work shall be uniform, of approved colour, smooth and free for runs, sags, defective brushing and clogging. Make edges of paints adjoining other materials of colours sharp and clean, without overlapping.

c) Finish

The painted surfaces shall present uniform appearance and semi –glass finish free from steaks, blisters etc.

1009. Emulsion Paint (Asian, Berger or Equivalent)

- **Material:**
The Emulsion paint is an exquisite emulsion paint that provides a luxuries finish and a silky appearance to the walls. The paint is also designed to prevent fungal growth on walls which also offers a unique anti-bacterial shield that kills ≥99% of microorganisms.

- **Product Features:**

Available Packs	: (1, 4, 10, 20) liters
Shelf Life	: 3 years from date of manufacture in original tightly closed containers away from direct sunlight and excessive heat.
Drying Time	: Surface dry time 10-15min
Sheen Levels	: 15-18 on glass plate at 85 degree
Flash point IS 101/1987 Part 1, Sec 6	: Premium Emulsion is a water based paint which is not flammable
Stability of thinned paint	: To be used within 24 hrs

Coverage *	: On normal masonry surface after brushing roller
	✓ 1 coat = 26-30 sq.m/ltr
	✓ 2 coats = 14-16 sq.m/ltr

*Actual coverage may vary from the quoted coverage due to factors such as method and condition of application and surface roughness and porosity.

- **Application:**
  - ✓ **Pre Painting Steps:**

a. **Plaster:** New masonry surfaces must be allowed to cure completely. It is recommended to allow 28 days as the curing time for new masonry surfaces.

b. **Cleaning:** Surface should be free from any loose paint, dust or grease. Growths of fungus, algae or moss should be removed by wire brushing and water. In case of areas having excessive dampness use Asian Paints Damp Block or equivalent to limit further dampness. When the underlying surface exhibits chalkiness, in spite of thorough surface cleaning, use Exterior Sealer.

c. **Filling for Cracks:** For filling cracks up to 3mm use Crack Seal.

d. **Filling for Holes & Dents:** In case of dents and holes use Wall Putty or white cement and fine sand in the ratio 1:3

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e. Apply 2 coats of Premium Emulsion for repairing for repainting and 3 coats for fresh surface painting

Application	Code	Thinner	Dilution%	Application Viscosity	Recoating Period
Step 1: Sanding	Sand the surface with sand paper 180 and Wipe Clean				
Step 2: First Coat Emulsion Paint Brush/Roller/Spray	0011	Water	Brush/Roller 60-70 Spray 70-75	Brush/Roller 20-30 Brush/Roller 20-25	3-4 Hr
Step 3: Second Coat Emulsion Paint Brush/Roller/Spray	0011	Water	Brush/Roller 60-70 Spray 70-75	Brush/Roller 30-45 Brush/Roller 22-25	3-4 Hr

*Recoat period is quoted for 28-30°C and 60-65% Relative Humidity, these may vary under different conditions. Spraying Air Pressure 2.75 to 3.5 kg/sq cm

On the plastered/putty surface, paint shall be prepared with sand papering, putting, and one coat of primer. The paint is applied in two coats of acrylic emulsion with roller or spray. The surface should be properly cleaned and treated with water based primer as per manufacturer's specifications. Rectification of defects in plaster, putty with broken edges should be done by using a proper colour putty, paste as per manufactures specifications.

The surface on which paint is applied shall become hard dry in 12 hours. The necessary single / multistage scaffoldings required for the work shall be provided as detailed out under coatings. The equipment, rollers or spray used on the work should be immediately washed with water to facilitate future use. After the first coat of the paint has hardened, the second coat is applied as instructed by the engineer. Similarly required number of coats shall be given to get an even and uniform shade.

✓ **Post Painting Care:**

- For removing stains, sponge clean with a mild soap solution and wipe clean. Ensure a drying time of 1 week before cleaning

➢ **Precaution:**

- ✓ Do not apply when ambient temperature is less than 10°C or if the temperature might drop to this level within 4 hrs of application.
- ✓ Do not over-thin or over-extend the brush.
- ✓ Tint using Asian Paints or equivalent machine colourants only
- ✓ Stir well and strain before use. Tinted paints need thorough shaking immediately after tinter addition as well as before use.
- ✓ Store the container with the lid tightly closed in an upright position, in a cool, dry place
- ✓ Keep out of reach of children and away from eatables.
- ✓ May be harmful if swallowed. In case of ingestion seek immediate medical attention.
- ✓ Wear eye protection during application. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
- ✓ In case of skin contact immediately wash skin with soap and plenty of water. Get medical attention if irritation develops or persists.
- ✓ Do not breathe vapour or spray.It is recommended to wear suitable nose pad during sanding and surface preparation to avoid dust inhalation.
- ✓ Do not pour leftover paint down the drain or in water courses. In the event of spills, contain spillage using sand or earth. No added Lead, Mercury or Chromium compounds

1010. Weather Coat Paint (Apex or Equivalent)

➢ **Material:**

The Weather Coat paint is a smooth water based, modified acrylic, exterior wall finish with silicon additives. It is specially formulated to withstand harsh environmental condition like rainfall, humidity and heat which provides extremely good protection against alkali and UV degradation thus ensuring that the shade doesn't fade for a long time and the paint lasts longer. It provides extremely good protection against

alkali and UV degradation thus ensuring that the shade doesn't fade for a long time and the paint lasts longer.

- **Product Features:**

Available Packs	: (1, 4, 10, 20) liters
Shelf Life	: 3 years from date of manufacture in original tightly closed containers away from direct sunlight and excessive heat.
Drying Time	: Surface dry time 30 min
Sheen Levels	: 2-5 at 60 degree GH
Flash point IS 101/1987 Part 1, Sec 6	:NA
Stability of thinned paint	: To be used within 24 hrs

Coverage *	: On normal masonry surface after brushing roller
	✓ 1 coat = 10-12 sq.m/ltr
	✓ 2 coats = 5-6 sq.m/ltr

*Actual coverage may vary from the quoted coverage due to factors such as method and condition of application and surface roughness and porosity.

- **Application:**
  - ✓ **Pre Painting Steps:**

a. **Plaster:** New masonry surfaces must be allowed to cure completely. It is recommended to allow 28 days as the curing time for new masonry surfaces.

b. **Cleaning:** Surface should be free from any loose paint, dust or grease. Growths of fungus, algae or moss should be removed by wire brushing and water. When the underlying surface exhibits chalkiness, in spite of thorough surface cleaning, use Asian Paints SmartCare Primero or equivalent.

c. **Filling for Cracks:** For filling cracks up to 3mm use Crack Seal.

d. **Filling for Holes & Dents:** In case of dents and holes use Wall Putty or white cement and fine sand in the ratio 1:3

Application	Code	Thinner	Dilution%	Application Viscosity	Recoating Period
Step 1: Sanding	Sand the surface with sand paper 180 and Wipe Clean				
Step 2: First Coat Weatherproof Exterior Emulsion Paint Brush/Roller/Spray	0012	Water	Brush 40 Roller 40 Spray 40	Brush/Roller 25-35 Brush/Roller 25-35	4-6 Hr
Step 3: Second Coat Weatherproof Exterior Emulsion Paint Brush/Roller/Spray	0012	Water	Brush 40 Roller 40 Spray 40	Brush/Roller 25-35 Brush/Roller 25-35	4-6 Hr

Weather coat paint shall be of approved Brand. The engineer shall examine the paints before seal is broken.

On the plastered/putty surface, paint shall be prepared with sand papering, putting, and one coat of primer. The paint is applied in two coats of acrylic emulsion with roller or spray. The surface should be properly cleaned and treated with water based primer as per manufacturer's specifications. Rectification of defects in plaster, putty with broken edges should be done by using a proper colour putty, paste as per manufactures specifications.

The surface on which paint is applied shall become hard dry in 12 hours. The necessary single / multistage scaffoldings required for the work shall be provided as detailed out under coatings. The equipment, rollers

or spray used on the work should be immediately washed with water to facilitate future use. After the first coat of the paint has hardened, the second coat is applied as instructed by the engineer. Similarly required number of coats shall be given to get an even and uniform shade.

- ✓ **Post Painting Care:**

For the best performance of the paint, ensure proper washing and cleaning of all algal and fungal growth, if any, at regular intervals of six months.

- **Precaution:**
  - ✓ Do not apply when ambient temperature is less than 10°C or if the temperature might drop to this level within 4 hrs of application.
  - ✓ Do not over-thin or over-extend the brush.
  - ✓ Tint using Asian Paints or equivalent machine colourants only
  - ✓ Stir well and strain before use.
  - ✓ Tinted paints need thorough shaking immediately after tinter addition as well as before use. For extremely rough surface including textures: Application by brush is recommended to ensure all the grooves are covered well.
  - ✓ Paint will not cover existing cracks, proper care to be taken to ensure the cracks are filled first and then topcoat is applied.
  - ✓ For surfaces having heavy algal infestation, proper cleaning followed by application of BIO BLOCK is mandated.
  - ✓ Primer coat or only one coat of topcoat should not be kept exposed in monsoon. Complete application before monsoon to be ensured.
  - ✓ Specially in pre-monsoon season, horizontal surface to be coated first and then vertical. This will help reduce the streak marks of algal growth if any.
  - ✓ For best performance ensure that the surface is dry. On moisture meter it should be under the green zone. In case it is in Red zone, find out the source of water and address it before painting.
  - ✓ pH of wall to be below 12, if higher use of Smart Care Primero or equivalent recommended.
  - ✓ Thinned paint should be consumed within 24 hrs of dilution. Accordingly, it is recommended to thin down only necessary amount of paint. Post 24 hrs thinned paint may be susceptible for microbial attack.
  - ✓ Ensure not to use Chlorinated water for dilution. Tinted paints need thorough shaking immediately after tinter addition as well as before use.
  - ✓ Store the container with the lid tightly closed in an upright position, in a cool, dry place
  - ✓ Keep out of reach of children and away from eatables.
  - ✓ May be harmful if swallowed. In case of ingestion seek immediate medical attention.
  - ✓ Wear eye protection during application. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
  - ✓ In case of skin contact immediately wash skin with soap and plenty of water. Get medical attention if irritation develops or persists.
  - ✓ Do not breathe vapour or spray. It is recommended to wear suitable nose pad during sanding and surface preparation to avoid dust inhalation.
  - ✓ Do not pour leftover paint down the drain or in water courses. In the event of spills, contain spillage using sand or earth.
  - ✓ No added Lead, Mercury or Chromium compounds. Left-Over Paint Disposal:
  - ✓ Left-over paint/drums should not be disposed in soil/drains. Consumers should consult a local recycling agency for proper disposal of paint/drums.

1011. Bituminous Aluminum Paint

Bituminous Aluminum paint shall be of approved Brand. The engineer shall examine the paints before seal is broken.

1012. Red Lead Primer

Red Lead primer paint shall be approved brand. The lead content in the paint shall be less than 60% by weight. The site in charge shall examine the paints before seal is broken.

1013. Chapra Polish

Chapra polish is prepared from the chapra mixed with spirit. Two layers of resin is applied by the smooth cotton clothes and dried.

a. Preparation of Surface

Before application of Chapra polish, the timber surfaces shall be thoroughly sand papered to obtain smooth surfaces and all the dust are removed from the surfaces. A coat of primer of chalk power mixed with resin or readymade approved putty is applied and sand papered to fill in the voids and joints.

b. Preparation & Application

The Chapra polish shall be made by mixing Chapra granules, thinner and spirit. The chapra must completely dissolve in the spirit. Over the primed surfaces, the Chapra polish of approved quality shall be applied with smooth cotton cloth with firm rubbing and spread evenly.

The cloth shall be of good quality and perfectly cleaned. Chapra wood finish shall be reapplied at least six times, after sandpapering with finer sand paper to get the final finish & best result.

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PART 1100 TILING AND FLOORING WORKS

1101 Scope

This Section of Specification applies to the placing and laying of ceramic tiles, split ceramic flags, other structural ceramic flags, wood-stone flags, glass tiles, glass wall panels, ceramic cellular wall-stones, porcelain tile, concrete tiles, marble, thermoplastic flooring tiles, PVC-flooring, terrazzo tiles, Granite slabs, concrete floor, wooden parquet floor, etc. in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

The works shall comprise the provision of labor and equipment, the supply of materials, structural components and building parts, including off-loading and storing on Site.

Tiling and flooring shall be applied in accordance with schedules for the finishing works given on drawings or specified elsewhere or as directed by the engineer.

The Contractor shall inspect all places where tiling and/or flooring are to be supplied.

If not otherwise stated, it shall obtain from the engineer instructions on type of tiling and flooring and in particular information on the color and surface structure and pattern of the tiles.

1102 Protection

All finishing on completion are to be adequately protected against damage by following trades or any other clause to the satisfaction of the engineer until the works are handed over to the owner.

1103 Where Changes in Floor Finish Occur

Where changes of floor finish occur they shall be divided by strips as specified.

The contractor's special attention is drawn to the fact that all screeds, immediately after the initial set has taken place, will be required to be continuously covered in water by the sand trap or other approved method for at least 10 days. Any screed panel that is found to be dry before the end of this period shall be removed at the discretion of the engineer.

1104 Brickbat Filling

Broken pieces of CSEB block shall be hard, tough, sound and durable to use as filling material for brickbat. No CSEB block pieces shall be more than 5cm. Boulders shall be laid in their natural bed. Smaller size boulders/pebbles shall be used to fill up gaps between boulder in order to form uniform well-knitted floor structure.

Measurement shall be in cubic meter of actual length, breadth and depth.

1105 Cement Concrete Flooring, Floor Screed and Skirting

1105.1 General Scope

This specification covers cement concrete floor neatly finished in general and ordinary or color Crete floor finish with or without cement concrete wearing coat and dado and skirting without concrete wearing coat in particular.

All work under this sub-chapter shall comprise all labor, equipment, and the supply of the appurtenant materials and structural components including off-loading and storage at the site required for performing flooring works, unless otherwise specified.

Flooring shall be carried out in accordance with the finishing schedules given on the drawings or specified elsewhere or as directed by the engineer.

The scope of works under this section will covers but not limited to the followings:

- Providing and laying 50 mm thick cement concrete screeding of mix 1:2:4 (1 part cement: 2 parts coarse sand: 4 parts 10 mm and down grade stone aggregate) with smooth finish for tile, parquet floor base, including mixing laying in required slope, intrigal finishing, curing, protection, etc., all complete as per specification, drawings and instructions of the engineer. The depth and pattern of the screeding shall be maintained keeping on the view of the thickness of upcoming floor finish layer.

The thickness of the screeding shall be increase to maintain the slope in the terrace and other outer areas.

- Provide and laying 3 mm thick cement sand punning of mix 1:1 (1-part cement: 1-part sand) including cleaning, watering, curing with smooth finish as per specification, drawing and instruction of the engineer.

- Providing, laying cement sand skirting 150 mm height with 16mm thick cement sand plaster of mix 1:4 (1 cement: 4 sand) with top layer of 3 mm thick neat cement punning finish including mixing, laying, rounding of junctions of floor and skirting, curing, protection, etc., all complete as per drawing, specification and instructions of the engineer.

1105.2 Reference Document

The work specified in this section shall be in accordance with the standards referred herein after, or other equivalent internationally accepted standards.

1105.3 Related Work

The Contractor shall become familiar with other Sections of the specifications affecting work of this trade.

1105.4 Samples/Submittals

The Contractor shall prepare a full mock-up for evaluation of surface preparation techniques and application workmanship for the approval of the engineer. The Contractor should not proceed with remaining work until workmanship and finished appearance are approved by the engineer.

1105.5 Materials

1105.5.1 General Requirement

All materials and structural components to be provided temporarily by the Contractor and not, therefore, ultimately incorporated in the work may be used or unused at the Contractor's choice, unless otherwise specified.

All materials and structural components to be supplied and installed by the Contractor and, therefore, ultimately incorporated in the work shall be new and unused, unless otherwise specified. They shall be suitable for their intended purpose and appropriately matched to each other. All materials and structural components not standardized shall be used only with the approval of the engineer.

The floorings shall be such as to provide a permanent surface that can be walked on. They shall not give rise to any unreasonable inconvenience. Deviations in color as against the samples may only be slight.

1105.5.2 Cement

Cement used shall confine to IS and shall be free from lump or such defects as specified in section 500.

1105.5.3 Sand

Sand shall be clean inner bed. Grain distribution shall be same as described under section 500.

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1105.5.4 Coarse Aggregate

Coarse aggregate used in cement concrete floors and beds shall be of approved colour and comply with IS 383 and IS 2386.

The grading of coarse aggregate when determined by testing shall be within the limits as given for 10mm single sized coarse aggregate in Section 500.

1105.5.5 Cement Pigment

Cement pigment to be mixed with Portland cement to provide coloured cement concrete shall confirm to BS 1014. The colour shall be as scheduled for coloured cement concrete and neat cement finish plaster.

1105.6 Execution

1105.6.1 Cement Concrete

Cement concrete of specified mix grade shall be used and it shall generally conform to the specifications under Section - 500.

1105.6.2 Preparation of Surfaces

The surface of concrete floors to receive screeds shall be roughened by removing the laitance with hacking axe, stiff broom and stippling immediately after the initial set of concrete. Floors shall be thoroughly swept and hosed down with clean water before the screed is laid. Base surfaces shall be wire brushed and watered for 3 to 4 hours. Immediately before laying the screed, a neat cement grout of creamy consistency shall be brushed over the sub-floor. The cement grout shall be mixed immediately before being used.

1105.7 Laying

1105.7.1 Base Concrete

Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah, Courtyard, kitchens & baths shall have slope as mentioned in the drawings and as decided by the engineer. Floors in water closet portion shall have the proper slope to drain off washing water. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10 mm will also be provided to avoid spread of water. Necessary margin to accommodate this drop shall be made in base concrete. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.

The flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete. Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry @ 2 kg of cement spread over an area of one sq.m. so as to get a good bond between the base and concrete floor.

1105.7.2 Thickness

The thickness of floor shall be as specified in the description of the item.

1105.7.3 Finishing

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided.

Fresh cement shall be mixed with water to form a thick slurry and spreaded @ 2 kg of cement over an area of one sq.m. of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth by trowelling or using power trowel as directed by the engineer.

The edges of sunk floors shall be finished and rounded with cement mortar 1:2 (1 cement: 2 coarse sand) and finished with a floating coat of neat cement.

The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

Wherever colour crete is specified, such work shall be applied only in the neat finish coat and finished similarly.

1105.7.4 Curing

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

1105.7.5 Precautions

Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the engineer. To facilitate rounding of junction of skirting, dado and floor, the skirting/dado shall be laid along with the border or adjacent panels of floor.

1105.7.6 Cleaning and Protection

The flooring shall be cleaned in after completion of the works. Flooring shall be protected until completion of project by a covering of heavy-duty building paper before foot traffic is permitted. Boardwalks shall be placed over flooring in areas where subsequent building operations might damage the floor.

1105.7.7 Skirting

Skirting shall be finished as finishing coat of the floor unless otherwise specified. The skirting work shall include racking and cleaning of base, watering, applying plaster work and neat finish. The level, line and corners shall be done carefully to get even, plumb and uniform surface through uniformity. The skirting work shall be done simultaneously with floor work or as directed by the engineer. The top edge of the skirting shall be chamfered to prevent dust collection.

1105.8 Measurement

Length and breadth shall be measured before lating skirting, dado or wall plaster. Measurement for payments shall be done in square meter or as indicated in the Bill of Quantities.

1105.9 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, equipment and incidentals required to complete the respective work as specified.

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Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard, maintaining slope in the terrace, toilets, courtyards and other outer surface and rounding off edges of sunken floors. In case the flooring is laid in alternate panels, nothing extra shall be paid towards the cost of shuttering used for this purpose.

1106 Tiling on Floor/ Wall and Skirting

1106.1 General Scope

This Specification applies to the placing and laying of porcelain glazed and non-glazed floor tiles & wall tiles etc.

1106.2 Reference Document

The work specified in this section shall be in accordance with the following standards, or approved equal, except as they are modified and supplemented herein:

SN	CODE	Description
1	BS EN ISO 10545-2	Methods for determination of particle size distribution
2	BS EN ISO 10545-2	Method for qualitative and quantitative petrographic examination of aggregates
3	BS EN ISO 10545-2	Methods for determination of particle shape
4	BS EN ISO 10545-2	Methods for determination of aggregate crushing value (ACV)
5	BS EN ISO 10545-4	Method for determination of aggregate impact value (AIV)
6	BS EN ISO 10545-7	Method for determination of aggregate abrasion value (AAV)
7	DIN 51094	Methods for determination of UV Light Resistance
8	BS EN ISO 10545-13	Method for determination of acid-soluble material in fine aggregate
9	BS EN ISO 10545-4	Specification for pigments for Modulus of Rupture
10	BS EN ISO 10545-11	Specifications for building sands from crazing
11	BS EN ISO 10545-3	Specification for waterproof building papers
12	BS EN ISO 10545-12	Pulverized-fuel ash – Part 1: Specification for pulverized-fuel ash for use with Portland cement
13	BS EN ISO 10545-14	Specification for Sulphate-resisting Portland cement or stains

1106.3 Related Work

The Contractor shall become familiar with other Sections of the specifications affecting work of this trade.

1106.4 General Requirement

The scope of work covered by this Chapter shall be deemed to comprise the furnishing and installation of all ceramic tiles flooring work shown on plans and as specified in finishing schedule or as mentioned in the Bill of Quantities. It shall also include the supply of the appertaining materials and structural parts, scaffolding, offloading on site and all operations in connection with tile flooring works, unless otherwise specified in the Bills of Quantities.

Flooring materials, which the Contractor shall supply and install and which thereafter will be incorporated in the structure, shall be new and unused. They shall comply with the regulations regarding quality and dimensions.

Materials that are not standardized shall not be used in the Works. The materials shall be protected from rain and inclement weather all to the satisfaction of the engineer. The cost of covering materials shall be deemed to be included in the unit prices for the flooring works.

1106.5 Samples/Submittals

The Contractor shall submit two full size samples of each tile in different colors and trim style along with manufacturing physical properties, manufacture's installation instruction and maintenance instructions for the engineer's approval prior to bulk purchase. The Contractor shall then secure that sufficient material is available at the site to proceed with the works without interruption due to lack of material. The Contractor shall provide all information, documentation, manufacturer's instructions, of tiling and flooring material and the method of laying or placing, including maintenance and cleaning directions for the end user.

The Contractor shall prepare a full mock-up for the approval of the engineer prior to proceed with permanent work. No work shall proceed without getting approval from the engineer in mock-up prepared by the Contractor.

The following tests shall be carried out by the Contractor and shall submit test reports for the approval of tile samples:

- Dimensions Requirements
- Straightness
- Rectangularity
- Surface Flatness
- Surface Quality
- Water Absorption
- Density
- Resistance to Deep Abrasion
- Breaking Strength and Modulus of Rupture
- Impact Resistance
- Resistance to Thermal Shock
- Slip Resistance

All tiles shall have to be approved by the engineer. Any tiles not up to the specification must be removed from the site immediately at Contractor's own cost.

1106.6 Materials

1106.6.1 General Requirement

Materials and structural parts, which the Contractor shall supply and install and which therefore will be incorporated in the structure, shall be new and unused. They shall comply with the regulations regarding quality and dimensions and appropriately match each other. Materials and structural parts that are not standardized but approved shall comply with the acceptance conditions.

Tiles and slabs shall have the properties stated below as far as there is no inconsistency with the characteristic properties of the tiles or slabs to be used:

- sharp, straight, parallel, non-crumbling edges;
- free from soluble salts and other detrimental constituents;
- free from cracks and blisters;
- true to agreed or standardized dimensions
- rear and side surfaces capable of bonding efficiently for the placing, laying and jointing.

Where tiles and slabs are not standardized, the quality features (e.g. parallelism of the edges, state and colour of the top surface, water absorption) shall satisfy the standard/first quality requirements.

Tiles and slabs, for which there are several grades, shall be of the Standard/First grade if not otherwise is specified in the Bill of Quantities.

1106.6.2 Porcelain Glazed Wall Tiles (Somany/ Kazaria or equivalent)

Glazed tiles are smoother and have more shine than of unglazed ones. Glazed tiles are thin with surface texture range from high gloss to mat and pebbly. They shall give a clear sound under a hammer stroke.

They shall be frost-proof, non-porous, abrasion resistant (2.5 mm after 3,000 hours) flexion and shock-resistant Acid (hydrochloric, nitric and sulphuric acid) attacks shall be less than 2.5% loss of their weight and their water absorbing capacity shall not be in excess of 0.4% of their dry weight (ref. to BS EN ISO 10545-3 or equivalent standards).

Porcelain Glazed Wall tiles shall be of approved make, color, texture and sizes as schedules, confirming to the requirements of BS EN ISO 10545, specifications for slip resistance classification of public pedestrian surface materials or other Internationally accepted standards.

The approved quality pinkish white body glazed/MATT/GLOSSY wall tiles of approved brand on 1:4 plaster using cement sand or mortar polymer-based tile. The joint will be filled with grout in a required color.

The required thickness is 8 mm (±0.5%), make in any colors, shades and size of 300x450 mm or as per drawings and Bill of Quantities, as approved by the engineer. It will be ±0.1% deviation in length and ±0.1% width, ±0.2 straightness of sides, ±0.2% rectangularity, 10% < E ≤18% water absorption, PEI class 2-4 resistance to surface abrasion, ≤ $7x10^{-6}$/°C coefficient of linear thermal expansion, ≥650N breaking strength, ≥16N/MM^2 modulus of rupture as per ISO 13006:2012, min class A resistance to household chemicals & swimming pool salt, class LA (no visible effect) resistance to Low concentrations acid & alkalis, min class 4 resistance to stain removed, crazing resistance(no crazing). All complete as per drawing and engineer's requirement.

Product test certificates required for items mentioned in the Bill of Quantities from the manufacturer's letterhead along with distributorship certificate needs to be submitted.

1106.6.3 Porcelain Non Glazed Floor Tiles (Somany/ Kazaria or equivalent)

Floor tiles for floor shall comply with the requirements and properties mentioned hereafter. They shall bear the identification mark of the manufacturer on the backside either in positive or in negative embossment.

The dimensions of the slabs shall be regular and constant, the upper surface plane, smooth and flawless without a trace of fissures or blotches. The sides shall be perfectly straight and the corners perfectly rectified. The shade and hue of the coloring shall be uniform.

The tiles shall be of approved make and shall generally conform to BS EN ISO 10545. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance.

The tiles shall be square or rectangular in size and regular in thickness and these tiles are to be supplied and laid on the floor. Thickness shall be 10mm ±5% for floor. The engineer shall choose the work size of tiles in order to allow a nominal joint width up to 2mm for unrectified floor tiles and up to 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer provided by the manufacturer. The joint gap shall be filled by grout with matching colour pigment.

1106.6.4 Cement

Cement shall be ordinary Portland cement as described in Section 500.

1106.6.5 Sand

Sand for mortar shall be naturally occurring sand as described in Section 500.

1106.6.6 Water

Water shall be as described in Section 500.

1106.6.7 Tile Adhesive

Tile adhesive shall be Polymer based with low volatile organic compounds (Low VOC), hydraulically setting, ready to use, waterproofing tile adhesive, confirming to BS 5980: 1980.

1106.6.8 Tile Grout

Tile grout shall be non-shrink fungus resistant polymer modified waterproof joint and tile grout.

1106.7 Execution

1106.7.1 General

All materials and structural components subject to processing instructions of manufacturers shall be processed in accordance with such instructions.

Prior to the start of it's operations under this sub-chapter, the Contractor shall verify that all conditions are suitable for the timely and effective carrying out of it's work. Where unsuitable conditions are found, they shall be reported in writing to the engineer and under the engineer's direction immediately corrected. In particular, the Contractor shall verify that such conditions as the following do not exist:

- major unevenness,
- unfilled masonry joints,
- major plaster projections,
- missing or insufficient slope or slope differing from that shown on construction drawings,
- efflorescence,
- tension and settlement cracks,
- unduly smooth surfaces,
- unduly moist surfaces,
- unduly absorbent surfaces,
- frozen surfaces,
- evidently or presumably detrimental substances, e.g. oil-fouled surf aces,
- lumps of gypsum

Work shall be carefully laid out to ensure symmetry about centerlines of the area involved and to minimize the use of less- than-half pieces of tiles, flags, slabs, etc.

The work shall be executed with the highest degree of precision and according to the drawings and specifications.

1106.7.2 Preparation of Surfaces

Unless otherwise specified, tiles shall be fixed in thin bed using tile adhesive with low volatile organic compounds (Low VOC). Prior to laying tiles cement screed of mix 1:2:4 (1 cement : 2 sand : 4 aggregate 10 mm and down grade) shall be laid over Concrete Slabs. Laitance, loose mortars and all previous finishes shall be removed, be scrabbled as required to form a roughened finish, thoroughly cleaned and primed with a bonding agent as specified in Section 500 – Concrete Work. Adequate bond between cement screed and concrete slabs shall be achieved. Line and level shall be maintained in the cement screed bed as per drawings and site condition. The thickness of bed shall be determined keeping in mind the thickness of tile and cement sand mortar or tile adhesive with low volatile organic compounds (Low VOC) to achieve the final finished level.

Where an adequate bond between the cement screed and the base is not ensured by the envisaged mode of execution, special measures shall be provided, e.g., roughening, overstretching the base with wire netting, or coarse-plastering of the complete surface.

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The screed surface to which tiles, flags, terrazzo, etc., are to be placed, shall be cleaned by wet sandblasting and washing with water under pressure, so as to produce the specified surface condition. The screed surface shall be kept thoroughly wet for a period of 4 hours prior to the placing of tiles, etc.

The subsurface of floor coverings shall be cleaned carefully prior to commencement of work.

The base for coverings to be placed without underlay shall be smoothed with filler compound. In the case of major unevenness, a suitable levelling compound shall be used.

Any filler or levelling compound shall be applied so that it will bond firmly and durably to the base, will not crack and will adequately withstand pressure.

1106.7.3 Placing Tiles

In interior finishing works, all tiles, flags, and mosaic shall only be set and laid after the fixing of window and door frames and trims, stop rails, plumbing installations and the application of plaster, unless otherwise specified.

All tiles, flags, and mosaic shall be set or laid plumb, in true alignment and horizontal or at the slope specified, without any projections, with regard to any specified reference and level lines. If special tiles with textured surfaces will be used in wall coverings, projections shall be accepted only to the extent allowed for by the particular type of tile or slab specified.

All tiles, flags, mosaic, or the like shall be set or laid in cement sand mortar or polymer based non-shrink mortar bedding, unless otherwise specified.

High polymer modified quick set tile adhesive with low volatile organic compounds (Low VOC) (conforming to BS 5980: 1980) shall be thoroughly mixed with water and a paste of zero slump shall be prepared so that it can be used within 1.5 to 2 hours. It shall be spread over an area not more than 1.5 sq.m. at one time. Thickness of adhesive shall be 1 - 2mm in no case shall be more than 5mm. The adhesive so spreaded shall be combed using suitable trowel. Tiles shall be pressed firmly in to the position with slight twisting action checking it simultaneously to ensure good contact gently being tapped with wooden mallet till it is properly backed with adjoining tiles. The tiles shall be fixed within about 25 - 30 minutes of application of adhesive. The surplus adhesive from the joints, surface of the tiles shall be immediately cleaned.

The surface of the flooring shall be frequently checked during laying with straight edge of above 2m long so as to attain a true surface with required slope.

Where full size tile cannot be fixed these shall be cut (sawn) to the required size and edges rubbed smooth to ensure straight and true joints. Tiles which are fixed in floor adjoining to wall shall enter not less than 10 mm under plaster, skirting or dado.

All tiles found to be hollow when tapped shall be replaced. All surplus mortars or grouts shall be removed before they have hardened.

Where floor drains are provided, the planes of the finished floor shall be sloped towards the drains. Intersections and returns shall be formed accurately. Cutting of tiles, where necessary, shall be done along the outer edges of the floor and done without marring the tile surfaces. Tiles shall fit closely and neatly around all plumbing fixtures and around electrical outlets, pipes, fittings, etc., so that cover plates or escutcheons will overlap the tiles properly. Tiles shall be secured firmly in place and loose tiles shall be removed and replaced.

Upon completion of the work, all surfaces of ceramic tiles shall be cleaned with a soap powder and clean water applied with stiff fibre brushes. After scrubbing, the tile surfaces shall be rinsed with clean water. Hard lumps of mortar shall be removed by using wooden paddles. Metal cleaning tools or metal brushes or acid solutions shall not be used. Where imperfections occur in jointing, the joint shall be raked back

not less than 8 mm in depth and the joint pointed full and tooled smooth to match adjoining work. All tile work shall be adequately protected against damage from subsequent building operations, both before and after cleaning.

1106.7.4 Jointing

The widths of joints shall suit the type of tiles, slabs and flags used, the purpose and stress of the coverings and the type of jointing chosen. The joints shall be equal in width for the entire area.

Unless otherwise specified, the tile shall have the following widths of joints:

For unrectified tiles: Minimum 2mm Max. 3mm

For rectified tiles: Min. 1mm Max. 2mm

All parting, expansion and connecting joints shall be closed with suitable sealing compounds approved by the engineer, unless other means are specified, e.g., elastic joint sections, open joints. All joints against dissimilar materials shall be raked out and filled with an approved silicone mastic sealant.

Parting joints in buildings shall extend into the wall and floor coverings at the same point and in an adequate width. No mortar bridging shall occur.

Expansion joints of the coverings shall penetrate to the bonding surface.

The joints between floor and wall tiles and the vertical corner connections shall be closed with silicone elastic sealing compound in accordance with the manufacturer's instructions.

1106.7.5 Pointing and Finishing

The joints shall be filled with polymer modified water proof joint mortar and tile grout. Joint filling operations shall be carried out as per the manufacturer's specification and instructions. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

1106.7.6 Special Requirements of Tiling Work

Installation

All joints of glazed and unglazed tiles shall be stack bonds and gagged edge units shall be used. Special units shall be provided as required to form all corners, returns, caps and offsets. All exterior corners shall be bullnose. Joints shall be raked out and pointed with non-shrink polymer grout as specified. As the work of laying and pointing progresses, the walls shall be cleaned with a cloth or burlap. Wall ties shall be of the type and spacing as recommended by the manufacturer.

At completion of the work, the walls shall be scrubbed with a brush using soap and water. No acid or metallic scrapers shall be used in cleaning.

Porcelain Tiles

Colour and sizes of the tiles shall be as approved by the engineer or as specified in drawings and Bill of Quantities.

Tiles shall be glued onto well prepared cement plaster on the walls or onto cement floors with cement sand mortar or special adhesives with low volatile organic compounds (Low VOC), the Contractor shall adhere to the instructions of the manufacturer of the adhesives. A prior approval by the engineer is required before using such adhesives.

Waterproofing

The bathroom walls and floors shall be waterproofed as per specification Section 1400, details shown on the drawings and Bill of Quantities. Before laying with wall and floor coverings, it shall be fully ensured that the walls and floors are properly waterproof and all plumbing fixtures are sealed against any leakage.

Dividing Strip

In order to separate different kinds of floor finish, a perforated flat bar of brass not less than 30 mm high shall be fixed in position before commencing of flooring. Strip thickness minimum 3 mm.

Skirting Tiles

Skirting tiles shall be of same quality as flooring materials and shall be from the same manufacturer of tiles. The height of the skirting shall be as shown in the drawings or mentioned in Bill of Quantities. The corner/junction of floor and skirting shall be round or fillet or straight type as shown in drawings or as approved by the engineer. The top line of the skirting shall flush with wall and shall be truly straight.

1106.8 Measurement

Measurement for payments shall be done in square meter or as indicated in the Bill of Quantities.

1106.9 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transportation, labor, equipment and incidentals required to complete the respective work as specified. The rate shall also include the following:

- cleaning the underlying surface;
- levelling minor unevenness's of base surface in setting or laying tiles in normal mortar bedding;
- removing minor plaster projections;
- joining coverings to adjacent installed structural components, such as frame, trims, stop rails, underlay rails, columns, sills, and the like;
- fixing loosely attached conduit boxes of electrical installations within the covering;
- expansion joints and sealing's in tiling, flooring and skirting to fulfil weather and water-tightness;
- jointing;
- access barriers to rooms until the flooring can be walked on and covering quarry tiles with sawdust;
- cleaning the sub-surfaces (base);
- preparing the base to achieve a good bonding surface, e.g., caustic or acid treatment or chipping if the condition of the base so requires;
- levelling unevenness's of the sub-surface as required with adequate compounds;
- All final cleaning and polishing as required for the material involved.

1200 FALSE CEILING WORKS

1201 Scope

This Section covers all labor, materials, services and equipment necessary for the supply and installation of False or suspended ceiling coverings with Metal Finish, Mineral Fiber, Gypsum, Acoustic etc. in accordance with the BOQ, Drawing and this Specification or as directed by the engineer. False ceiling shall be of the sizes and conforming to the details shown on the Drawings, Bill of Quantities and mentioned elsewhere.

1202 Related Works

All work under this Section shall be properly coordinated with the work of other Sections/Sections. Lighting fixtures and outlets for the air-conditioning system shall be integrated into the suspended ceiling by means of special carriers and shaped metal frames matching the selected type of openings and meeting the additional load.

1203 Submittals

The following submittals are required prior to start of the works:

- **Product Data:** Provide manufacturer's product data sheet for each type of stud, track, channel, mineral fiber false ceiling board, acoustical suspended ceiling system, metal finish false ceiling board, WPC baffled ceiling, woodworks false ceiling panels, gypsum board, laminating compound and adhesive with low volatile organic compounds (Low VOC) and accessory in accordance with general requirement. Proposed products to be reviewed prior to ordering and shipping.
- Prior to ordering and shipping submit two (2) copies of manufacturer's standard details, materials, components, finishes and installation instructions.
- **Shop Drawings:** The Contractor shall prepare and submit the shop drawings showing details of the building and their relationship to electrical, air-conditioning system and other services and other conditions of the ceiling system. All shop drawings shall be submitted for approval no later than two (2) weeks prior to the start of Works.
- **Asbestos –Free Certification:** Submit manufacturer's written certification that all materials are free of asbestos.
- **Mock-up:** Provide full scale mock-up (more than 10 sq. m.) including edge details, finishing around openings and fixtures to demonstrate method of works, aesthetic and qualities of materials and execution.

Advice client/engineer with 24 hours' notice that mock-ups are ready for inspection.

Once approved, mock-ups will be the material and workmanship standard for this contract. Approved mock-ups installed locations may become part of the installed for ceiling work.

1204 Materials

- **General Requirement**

Materials and building components which the Contractor has to supply and build in, i.e. they go into the permanent works, must be new and unused. They must comply with standards and dimensions.

- **Products**

a) Designed Gypsum board False ceiling

The board shall be 9.5 mm-12mm thick (or as specified) Gypsum board tiles of 610 x 610 Board mm size (or as per design) conforming to IS 2095: 1982 & 2542-1981. The tiles shall be plain, textured or designed with design patterns as per drawings or approved by site engineer. The suspenders are galvanized mild steel straps of 28G and horizontal and transverse members are galvanized mild steel channel of 16 G. Construction Procedures

Frame Work: The frame work shall be of zinc coated mild steel or galvanized iron (G.I. framing) and shall consist of 45 mm sq. or 50 x50 mm square tubes of 18G as main runners as specified in the item at

specified spacing welded together with 45 mm x 45 mm zinc coated Gypsteel branded channels, or 50 x 50 mm G.I. channels of 18G as runners at specified spacing. The above frame shall be suspended from existing RCC slab with adjustable 25 x 4 mm mild steel flats welded at top to reinforcement bars, including exposing the reinforcement bars and making good the damages with cement mortar as specified in the item and drawings.

Expanded Metal: Expanded metal shall be fixed with the long way of the mesh across the supports. The strands in the various sheets shall all slope in one direction, in vertical work they shall also slope inwards and downwards from the plaster face. To ensure continuity of key at the fixing points small round rods, V-shaped ribs or strips of hardwood shall be fixed on the face of the supports. All sheets shall be lapped not less than 25-mm at the sides and ends, overlaps shall not occur only at supports. Sides of the sheets shall be wired together with galvanized wire of not less than 18 SWG, at every 75 mm between supports. Cut ends of wire used for fastening etc. shall be bent inwards and not towards the plaster finishing coat. The expanded metal shall be secured to supports by means of galvanized staples at intervals of not more that 100-mm. It shall be secured to steelwork by wire or clips.

The fixing centres should normally be not greater than 350 mm for mesh weighing 1.2 kg/sq.m. of 10 or 6 mm mesh. Care shall be taken to ensure that the anti-corrosion treatment is in good condition after fixing.

1205 Delivery, Storage and Handling

Deliver materials in manufacturer's original unopened packages clearly marked with identifying information. Protect materials as recommended by the manufacturer.

Store materials, keep dry, and protect against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

Boards should be stacked flat on dry and smooth area and avoid ground dampness. Use 40 mm x 75 mm wooden sleepers as a support. The boards should be kept indoor. As far as possible boards should be delivered directly to the site to avoid damage during re-handling. Boards should be stacked flat on the floor, instead of leaning them against the wall.

1206 Quality Assurance

Manufacturer: Provide products of manufacturer with no less than 10 years' experience in manufacturing the false ceiling materials for the required work. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.

Provide a complete false ceiling system from single manufacturer specializing in the production of this type of work.

Installer: All ceiling works shall be carried out with the approved installer of the manufacturer/ dealer. Ceiling installer shall use only skilled craftsman, trained and experienced in the specialized materials and method of the system specified.

1207 Warranty

Provide manufacturer's standard warranty of no less than one year.

1208 Execution

- **General**

The manufacturer's recommended site conditions for the installation of their materials should be followed. Ceiling system shall be strictly installed in compliance with Manufacturer's instructions, specifications and recommendations for clip-in concealed grid ceilings.

Suspended ceilings are essentially a finishing trade and therefore the building shall be in a suitable condition with regard to cleanliness, temperature and relative humidity before installation begins. The building shall be fully enclosed, and all wet work shall be completed and dried out unless the manufacturer's recommendations allow otherwise.

All works above the suspended ceiling shall be completed before the suspended ceiling is installed with the exception of connections and balancing adjustment to services.

Lighting fixtures and outlets for the air-conditioning system, smoke detectors, speakers and other services shall be integrated into the suspended ceiling by means of special carriers and shaped metal frames matching the selected type of openings and meeting the additional load.

Ceiling materials shall withstand fire minimum for 30 minutes or the rating of the materials at vicinity.

All ceiling systems shall be installed in a true, even plane, in straight courses as indicated on drawings and in compliance with approved shop drawings.

At locations shown on the drawings or as instructed by the engineer, removable inspection accesses shall be provided in the ceiling construction. These access hatches shall be adapted to the pattern of the ceiling.

- **Setting Out and Levelling**

Sufficient information shall be clearly indicated on the shop drawings to enable the ceiling module and setting out points in each ceiling area applicable to all relevant trades to be established early. All trades should work to the same setting out points and data.

The ceiling height in each area shall be marked in relation to the elevation bench marks and then transferred by means of water level, or rotating laser or other device.

Each ceiling area shall be measured to establish layout of panels to balance the border widths at opposite edge of the each ceiling. Using less than half width tiles at border shall be avoided.

- **Top Fixing**

Before top fixing are installed, the suitability of the building structure from which the ceiling is to be suspended shall be verified.

Preferably all top fixings shall be installed at the same time to maintain and ensure the accurate spacing.

Top fixing shall be installed strictly in accordance with the fixing device manufacturer's instructions.

- **Hangers Fixing**

Hangers shall be spaced in accordance with the recommendations of the manufacturer of the ceiling system. Extra hangers shall be provided for the additional loads coming from light fixtures, HVAC grilles, and other services.

Rivets shall not be used to secure top or bottom of angles or straps. Hangers shall be secured to the supporting structure with approved fastenings. Hangers and fastenings shall be capable of carrying at least 4 times the design load but not less than 50 kg.

Where hangers cannot be fixed at the recommended spacing due to the presence of services equipment or other obstructions, a sub-grid of appropriate span performance shall be used. It shall be securely supported to prevent lateral movement.

All hangers shall be truly vertical and shall not be in contact against insulation, ducts, pipes or other services within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means shall be employed.

If the ceiling is likely to be subjected to upward movement, e.g. wind pressure, cleaning procedures etc., the hangers shall be galvanized mild steel angle or other some rigid sections.

- **Primary Support Channel**

Unless otherwise specified, installations shall be done strict in accordance with the manufacturers published specification, installation instructions.

The primary support channels shall be installed in proper line and level. Levelling shall be done with supporting hangers taut to prevent any subsequent downward movement when the ceiling loads are applied. Kinks and bends shall be made in hanger wire or straps as a mean of leveling.

Where hanger wires are around primary channels the wire shall be wrapped around twice and the loops shall be tightly formed to prevent any vertical movement or rotation of channel within the loop.

- **Perimeter Trim (Termination at Walls)**

The main beams and cross tees which terminate at the walls shall be attached to a perimeter wall molding, which shall be continuous along at least 2 (two) intersecting walls, with spring steel clips. Perimeter trim shall be neatly jointed at all external and internal angles. Straight run joints shall be neat and adjacent lengths truly in line. Wall molding shall be securely attached to the walls at approximately 300 mm intervals.

- **Splines**

Splines shall be used between infill units to ensure that the adjacent infill units are level and to resist air movement through the infill unit joints.

- **Infill Units (Panels)**

Unless otherwise specified, installation of infill units shall be as specified in the manufacturer's published specifications, instructions and recommendation.

Unless otherwise indicated, the layout scheme shall be such that all ceiling panels are symmetrical about the center of the rooms to provide the least number of cut panels. The panels shall be laid in a pattern with all edges in alignment and with all faces in a plane. There shall be no noticeable variations in the finished ceiling plane. Items located within the ceiling plane such as light fixtures, air diffusers, speakers, and smoke detectors etc. shall be coordinated with other trades and shall be installed at the locations indicated.

Infill units shall be handled with care to prevent soiling. They shall be installed in a uniform manner and care shall be taken to avoid dimensional creep by frequently checking that a given number of units cover the correct total dimensions.

All infill units in concealed grid systems shall be straight and in alignment. Infill units surrounding recessed luminaires and similar openings shall be installed and secured to as to prevent movement or displacement of units.

Infill units cut at perimeters shall be trimmed to the full space between the last grid member and the perimeter trim to prevent subsequent movement. Cut edge of the infill units remaining exposed after installation shall be painted to match the colour of exposed panel surfaces using coating recommended in writing for this purpose by gpanel manufacturer.

- **Control and Expansion Joints**

Construct expansion joints as detailed at building movement and construction joints with continuous dust barrier. Caulk the control joint closed prior to placing panels.

Do not bridge building control and expansion joints with steel framing or furring members. Provide independent frame on both sides of joints independently.

- **Access Panels**

The Contractor shall provide the access panel in concealed grid ceiling at the required places as indicated in the drawings or as directed by the engineer. The details of the access panels shall be as per the manufacturer's recommendations, instructions and specification. There shall be minimum of one access panel in one room.

- **Deflections**

The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than 1/360 of the span and shall be level to within 3 mm in 4 meter. The ceiling system shall conform to the manufacturer's guidelines with a minimum load carrying capacity of the main runner of 23 kg/linear meter.

1209 Measurement

Measurement of works will be made as specified in the BOQ.

1210 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transportation, scaffolding, labor, equipment, accessories, installation, testing, commissioning and incidentals required to complete the respective work as specified.

1300 WATER PROOFING WORKS

1301 Scope

This Section covers furnishing of all materials, labor, tools, and equipment required in undertaking proper application of water proofing works as shown on the Plans and in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

1302 General

i. Section Includes

A. Furnishing of all labor, materials, services and equipment necessary for the supply and installation of cementitious crystalline waterproofing on concrete structures and surfaces as shown on drawings and as specified in this section.

B. Related Sections:

1. See Section 03300 - Cast-in-Place Concrete
2. See Section 07900 – Joint Sealers
3. See Section 09900 - Paints and Coatings

ii. References

A. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

B. ASTM C 321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.

C. ASTM C 348 - Standard Test Method for Flexural Strength of Hydraulic Cement Mortars.

D. ASTM C 596 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.

E. COE CRD-C 48-92 - Method of Test for Water Permeability of Concrete; U.S. Army Corps of Engineers.

F. NSF/ANSI Standard 61 - Drinking Water System Components – Health Effects (for use of waterproofing material on structures holding potable water).

iii. Submittals

A. General

Submit manufacturer's certification that proposed materials, details and systems as indicated and specified fully comply with manufacturer's details and specifications. If any portions of contract documents do not conform to manufacturer's standard recommendations, submit notification of portions of design that are at variance with manufacturer's specifications.

B. Product Data

Submit manufacturer's descriptive literature and product specifications for each product.

iv. Quality Assurance

A. Manufacturer Qualifications

Company specializing in manufacturing and/or marketing Products specified in this Section with minimum 5 years documented experience.

B. Installer Qualifications

Acceptable to manufacturer with documented experience on at least 5 projects of similar nature in past 2 years and/or training provided by the product manufacturer.

v. Delivery, Storage and Handling

A. Deliver, store off the ground and covered, handle and protect products from moisture in accordance with manufacturer's instructions.

B. Deliver materials in manufacturer's unopened containers, fully identified with brand, type, grade, class and all other qualifying information. Provide Safety Data Sheets for each product.

C. Take necessary precautions to keep products clean, dry and free of damage.

vi. Warranty

Warrant installed waterproofing to be free of leaks and defects for 5 years from date of acceptance, with the exception of structural cracks in the waterproofed concrete which are 0.02" (0.4 mm) or wider or any size dynamic cracks.

vii. System Requirements

A. Coordinate waterproofing work with work of other trades.

B. Provide materials and accessories in timely manner so as not to delay Work.

viii. Project Conditions

A. Maintain surfaces to be waterproofed and surrounding air temperature as well as concrete temperature at not less than 40° F (5 ° C) for at least 48 hours before, during and after application of waterproofing.

B. Do not apply materials to frozen or frost-filled surfaces.

C. Exercise caution when temperatures exceed 90 ° F (32 ° C). It may be necessary to apply waterproofing during times when the sun is not at its strongest (i.e. early morning, evening or night).

ix. Warranty

Manufacturer shall provide standard limited product warranty executed by authorized company official. Term of warranty shall be 5 years from date of Substantial Completion, if Substantial Completion is no longer than 6 (six) months after product application.

1303 Products

1303.2 Polymer Modified Cementitious Acrylic Based Water Proofing System (Aquafin 2K/M or Equivalent)

➢ **Materials:**

Cementitious composite waterproofing coating system is a flexible elastomeric 2 component polymer modified coating that waterproofs and protects concrete, masonry, brick and some natural stone substrates with crack-bridging properties. The system should exhibit crack bridging up to 2 mm excellent bond strength, high wear resistance and chemical resistance with reduced permeability. The material should have UV, weather and freeze thaw resistant. The material should be manufactured by company that manufactures entire range of construction chemicals under compliance of ASTM D 412-98 and EN/DIN.

The polymer modified arcylic base two component water proofing are mostly used on toilet floor, terrace ,balcony etc. The flexible waterproofing coating shall be applied in two layers in horizontal and vertical strokes, when each coat is in tacky condition, Aquafin-2K/M plus or equivalent having cTack-bridging to ASTM C836: > 2.0 mm Elongation, to ASTM D 412-16: ca. 192 o/o and Water tightness when installed: 2.5 bar meeting the (ASTM D 412-98 a) over the prepared RCC slab and on the vertical surfaces . After 3 days ponding the area with water, for the water tightness shall be tested etc. as per instruction of site engineer all complete.

The waterproofing is seamless and joint less finish with flexible and crack-bridging waterproofing suitable for all load-bearing substrates, conventionally used in construction which bonds to damp substrates without priming.

- ✓ Vapor permeable, resistant to frost, UV and ageing, resistant to de-icing salts
- ✓ Very low emission ECI PLUS R in accordance with GEV-EMICODE.
- ✓ Structural Water proofing in accordance with DIN 18533, DIN 18535 and DIN EN 1504-2.
- ✓ Bonded waterproofing membrane with tiles and slabs in accordance with DIN 18531, DIN 18534, DIN 18535 and DIN EN 14891
- ✓ Resistant to solutions which are aggressive to concrete up to XA2

➢ **Technical Data:**

	UNIFLEX-M-PLUS	Power component AQUAFIN
Basic	Polymer dispersion	Sand, cement, additives
Mixing Ratio	1 part by weight	2.5 parts by weight
Packaging	10 kg, 6 kg, 2 kg	25kg, 15 kg, 5 kg
Color	white	grey

Density	: approx. 1.6g/cm^3
Pot life at 23°C and 50% relative humidity *	: approx. 60 minutes
Overcoat after **	: approx. 3-6 hrs
Substrate/application temp.	: +5°C to +35°C
Tensile Adhesion strength to DIN EN 1542	: 1.0 N/mm2
Crack-bridging to DIN 28052-6 (PG MDS/AIV)	:0.4 mm
Crack bridging to DIN EN 14891 at normal and low temp.	: ≥0.75 mm
Crack bridging to ASTM C836	: >2.0 mm
Elongation, to ASTM D 41 2-16	: ca. 192 %
Water tightness when installed	: 2.5 bar
Water vapor transmission coefficient μ	: approx. 1,200
Sd value at 2mm Dry film thickness	: approx. 2.4 m
Transmission coefficient, CO2, μ	: >100000
Sd value CO2 at 2.0mm dry film thickness	: 200 m
Reaction to fire DIN EN 13501-1	: E

**Due to project and weather conditions, the given data may extend or shorten. High temperatures and low humidity decrease whereas low temperatures and high humidity increase the drying time.*

*** Ready for exposure:*

- *Rainproof on sloped surfaces after approx. 6 hours, prevent standing water.*
- *By foot traffic after approx. 1 day*
- *By pressurized water after approx. 7 days*
- *Coverable by tiles after approx. 1 day*

➢ **Preparation:**

Approx. 50 - 60% of the liquid component should be placed into a clean mixing bucket and pre-mix with the powder component to create a homogenous, lump-free mass. Then, the remaining liquid component is added and adequately blend. With a mechanical mixer (approx. 500 – 700 rpm), a mix time of approx. 2 - 3 mins is required. The mixture is allowed to stand for approx. 5 minutes, thoroughly homogenize by mixing once again. Mixing AQUAFIN-2K/M-PLUS is carried out with the following mix ratio, parts by weight: 2.5 parts powder component: 1-part dispersion component. Due to project or application conditions, e.g. application in the screen or spray technique, water addition of up to a maximum of 1.5 % (0.5 l/35 kg) AQUAFIN-2K/M-PLUS is permitted. Water is added after mixing the powder and liquid component.

➢ **Application:**

AQUAFIN-2K/M-PLUS is applied, free from pores, by brush or trowel in at least two coats. The second, as well as subsequent coats may only be applied on the first coat cannot become damaged by foot traffic or by further coating applications (approx. 3–6 hrs, depending on ambient conditions).

A consistent thickness, dependent on exposure conditions, is achieved e.g. by a 4 to 6 mm notched trowel and subsequently smoothing. The material is used as much as required to achieve the dry film thickness necessary for the water exposure class. An application thickness of more than 2.2 kg/m2 in a single coat can lead to crack formation and is to be avoided. For application in the spray technique with suitable spray equipment, e.g. HighPump M8 (peristaltic pump), HighPump Small or HighPump Pictor (screw pump), we recommend a nozzle size of 4.5 to 6.0 mm.

To form water resistant expansions and construction joints, incorporate the ASO-Joint-Tape technology system components appropriate to the particular water exposure class. AQUAFIN-2K/M-PLUS, bond ASO-Joint-Tape-2000/-S or ASO-Joint-Tape-2000/-S-Corners should be applied (internal and external corner pieces) in the corner areas, at the transition between wall and floor as well as over connection joints. Using a 4–6 mm notched trowel, AQUAFIN-2K/M-PLUS shall be applied to both sides of the joint that is to be bridged.

AQUAFIN-2K/M-PLUS has to be at least 2 cm wider than the joint tape to be used. The joint tape is laid into the wet layer and then carefully press in without folds or voids. Bonding must be carried out in such as way as to eliminate the possibility of water migration around the back. The joint tape should be laid in a loop over expansion joints. Waterproof tape joints should be overlapped by a minimum of 5 to 10 cm and bonded with AQUAFIN-2K/M-PLUS without folds or voids. Subsequently overcoat the bonded joint tapes with AQUAFIN-2K/M-PLUS and seamlessly integrate into the main waterproofed areas. Follow the same procedure when installing ASO-Joint-Tape pre-formed pieces.

➢ **Precautions:**

- The areas that are not to be treated with AQUAFIN-2K/M-PLUS! should be protected.
- During the curing process, the waterproofing shall not be exposed to water. Water penetrating from the rear can lead to de-bonding in frost.
- In case of strong sunshine, work shall be performed against the direction of the sun in the shade.
- In rooms with high humidity and / or inadequate ventilation (e.g. water containers), the surface may drop below the dew point (condensation). This can be prevented by using suitable measures such as e.g. dehumidifiers. Direct heat or uncontrolled blown warm air is not reliable.
- As a surface waterproofing, AQUAFIN-2K/M-PLUS may not be subjected to point or linear loading.
- AQUAFIN-2K/M-PLUS can be rendered and also coated with vapour permeable, solvent free dispersion based facade or silicate paints (do not use pure silicate paints). Silicone resin or acrylate-based paints can also be used.
- Direct contact with metals such as copper, zinc and aluminium is to be prevented by a porous-free priming coat, produced with two coats of ASODUR-GBM. Apply the first coat to saturation to the degreased and cleaned substrate. Once this coat has reacted to a point where it will no longer accept a broadcasting sand (approx. 3–6 hrs.), apply a second coat of ASODUR-GBM and broadcast with 0.2–0.7 mm quartz sand. Consumption approx. 800-1000 g/m² ASODUR-GBM.
- To seal PVC, red brass and stainless steel flanges, abrade the flange, clean degrease, apply AQUAFIN-2K/M-PLUS and ASO-Dichtmanschette or alternatively the ADF-Rohrmanschette bedded without voids or folds and seamlessly connect with the surrounding waterproof membrane. Follow the pertinent current regulatory works. Please observe the valid EU safety data sheet

1304 Curing

A. Follow manufacturer's general instructions for curing and hardening of waterproofing material. Do not use water for curing. Waterproofing material is self-curing.

B. Protect surfaces from rain, frost and premature dehydration.

1305 Testing of Water Including Structures

Following application and completion of related work, as required, but well prior to completion of entire project, fill tanks to capacity and allow to be filled not less than 3 days. Fill larger structures at a uniform rate not greater than 6.5 feet (2 m) in 24 hours. The temperature of the fill water shall be plus or minus 10 degrees F of the ambient air and/or the tank structure at the time of filling. Extreme caution is urged if the temperature is greater than 10-degree F. Should leakage occur after this period, drain tanks to perform repairs. Notify Owner prior to draining tanks.

1306 Acceptance

A. Remove left over materials and any foreign material resulting from the work from the site.

B. Clean adjacent surfaces and materials.

1307 Measurement

Measurement for payments shall be done as indicated in the Bill of Quantities.

1308 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, equipment and incidentals mentioned above required to complete the respective work as specified.

1400 LANDSCAPING WORKS

1401 Scope

This Section covers all labor, materials, services and equipment necessary for the supply, laying and planting of carpet dubo and trees in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

1402 Related Works

All work under this Section shall be properly coordinated with the work of other Sections/Sections. Outdoor lighting fixtures, water supply and other service system shall be integrated into the landscaping works.

1403 Interlocking Concrete Blocks

a. General Scope

This specification covers the pavement of heavy duty interlocking blocks in the crusher dust in general. Flooring shall be carried out in accordance with the finishing schedules given on the drawings or specified elsewhere or as directed by the engineer.

b. Related Work

The Contractor shall become familiar with other Sections of the specifications affecting work of this trade.

c. Samples/ Submittals

Before starting the work, the contractor shall submit the samples of interlocking blocks for the approval of the engineer. Good quality blocks shall be handpicked from the dismantled interlocking blocks for sample and for work. Approved samples shall be kept in the custody of the engineer and the block used on the work shall conform to samples with regard to soundness, colour, veining and general texture.

The Contractor shall also prepare a full mock-up for evaluation of surface preparation techniques, application workmanship and finishing for the approval of the engineer. The Contractor should not proceed with remaining work until workmanship and finished appearance are approved by the engineer.

d. Materials

All materials and structural components to be supplied and installed by the Contractor under this trade and incorporated in the work shall be new and unused, unless otherwise specified. They shall be suitable for their intended purpose and appropriately matched to each other.

All materials and structural components not standardized shall be used only with the approval of the engineer.

e. Execution

The blocks shall be laid on either concrete or compacted sand-gravel or crusher dust as indicated in the Drawing. In the case of cement sand base, it shall be 1 part cement; 4 parts sand and mixing shall be done as per specification for mortar mixing of brick masonry work laid to the dimensions, lines and levels shown in the Drawing and well compacted by ramming or other means or as instructed by the engineer.

In the case of crusher dust base, it shall be 50 mm thick and in line and levels as shown in the drawing or as instructed by the engineer.

Mortar of specified mix shall be spread under each block. The block shall be washed clean before laying. It shall then be laid on top, pressed, so that all hollows underneath get filled and surplus mortar works up through the joints. The top shall be tapped with a wooden mallet and brought to level and close to the adjoining blocks, with thickness of joint not exceeding 1 mm. Subsequent blocks shall be laid in the same manner. After laying each block surplus mortar on the surface of blocks shall be cleaned off and joints finished flush.

The finished floor shall not sound hollow when tapped with wooden mallet.

All work finishing shall be adequately protected from damage during the process of construction till completion and any damages shall be repaired to the satisfaction of the engineer at the contractor's own expense.

Upon completion prior to final inspection of acceptance, the contractor shall clean all work. Acids or other agents liable to damage the work shall be avoided. If surface shows mass scratches, cracks or other imperfection which cannot be removed by the cleaning, the contractor shall remove the defective material and replace with new material at his own cost.

f. Measurement

Measurement for payments shall be done in square meter or as indicated in the Bill of Quantities.

g. Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, equipment and incidentals mentioned above including providing setting mortar, joint filling, joint pointing, application of cement slurry on RCC slab or on base concrete including roughening and cleaning the surface, the cost of dividing strips, etc. required to complete the respective work as specified.

1500 SEISMIC AND EXPANSION JOINT TREATMENT WORKS

1501 Scope

This specification covers furnishing of all labor, materials, services and equipment necessary for the supply and installation of Imported Seismic and Expansion Joint Cover Assemblies in the areas in accordance with the BOQ, Drawing and this Specification or as directed by the engineer.

This Specification applies to the following types:

a. Interior Floor expansion joint covers.

b. Interior Wall/Columns expansion joint covers.

c. Interior Ceiling expansion joint covers.

d. Exterior Floor expansion joint covers.

e. Exterior Wall/Columns expansion joint covers.

All services also include supply of the materials and building components connected therewith, including unloading and storage on the building site, unless stated to the contrary in the Bill of Quantities.

Any specifications not mentioned hereunder but stipulated under other Sections of Work shall also be applicable for this chapter.

1502 Reference Standards

- The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- All materials, installation and workmanship shall comply with all applicable requirements and standards referred here after.
- ASTM E1251-2011 ASTM E8/E8M-2013a
- ASTM B211-2008

1503 Related Work

The Contractor shall become familiar with other Sections of the specifications affecting work of this trade.

1504 Submittals

1504.1 Samples

- Samples for initial selection purposes shall be submitted in the form of manufacturer's color charts, actual units, or sections of units showing full range of colors, textures, and patterns available for each exposed metal and elastomeric material of expansion joint cover assembly indicated.
- Samples shall be submitted for verification purposes in full size units of each type of expansion joint cover assembly indicated; in sets for each finish, color, texture, and pattern specified, showing full range of variations expected in the characteristics.

1504.2 Record Documents

- Submit manufacturer's specifications and technical data, including Material Safety Data Sheets, installation instructions, and, as required, catalog cuts and templates to explain construction and to provide for incorporation of the product into the project.
- Submit shop drawings showing complete fabrication details for all joint covers, including required anchorage to surrounding construction, recesses, blocking, backing and connections between similar and dissimilar joint cover assemblies.
- Submit detail drawings of special accessory components not included in the manufacturer's product data.

1505 System Description

Design Requirement: Manufacturer/Dealer is to be responsible for designing units, including anchorage to structural system, transitions, direction changes, and necessary modifications to meet specified requirements and maintain visual design concepts. Provide concealed fastening wherever possible.

1506 Quality Assurance

Single Source Responsibility: Unless otherwise acceptable to the Client/engineer, obtain expansion joint cover assemblies specified in this Section from one source from a single manufacturer/dealer. Coordinate compatibility with expansion joint cover assemblies specified in other sections.

Manufacturer shall be ISO 9001:2000 Certified and shall have a minimum of ten (5) years of experience in the fabrication of expansion joint cover assemblies.

Installer: Installation firm shall have not less than three (2) years of successful experience in the installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

1507 Materials

1507.1 General Requirement

Materials and building components which the Contractor has to supply and build in, i.e. they go into the permanent works, must be new and unused. They must comply to standards and dimensions.

For unstandardized materials and building components, the Contractor shall supply samples and name the manufacturer. They must be approved by the engineer.

1507.2 Products (Spring Thunder or VSIL or Bituflex or Equivalent)

An expansion joint, or movement joint, is an assembly designed to hold parts together while safely absorbing temperature-induced expansion and contraction of building materials.

The expansion joint used for walls are adaptable to many finishes including dry wall and tile. The joint should have clear anodized finish standard in which cover plate can be powder coated, painted or wall papered to match adjacent wall finishes. The centering bars correctly re-center plate and allow for multi-dimensional seismic movement. This is most popular and economical solution for retrofit and surface mounted installation which has serrated surface and beveled edges for pedestrian's safety.

Horizontal floor expansion joint for slab **(3mm thick galvanized steel)** with feasible movement capacity, joint width 300mm, with water barrier as per drawings, specifications, instruction & approval of Site Engineer all complete. (Spring Thunder or VSIL or Bituflex or equivalent)

Ceiling expansion joint with alumunium plate **(3mm Thick)** with feasible movement capacity, joint width 300mm, with water barrier and top seal gaskets for the center plate screw of the roof cover for the water tight transition as per drawings, instruction & approval of Site Engineer all complete.

1507.2.1 Expansion Joint Cover Assemblies

a. Provide expansion joint cover assemblies of design, basic profile, materials, and operation indicated. Provide units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces, and dynamic structural movement without material degradation or fatigue when tested according to ASTM E 1399. Furnish units in longest practicable lengths to minimize number of end joints.

b. Provide hairline mitered corners where joint changes directions or abuts other materials. Include closure materials and transition pieces, tee joints, corners, curbs, cross connections, and other accessories as required to provide continuous joint cover assemblies.

c. Moisture Barrier: Provide manufacturer's continuous, standard, flexible vinyl moisture barrier under covers at locations indicated.

1507.3 Materials

a. Aluminum: ASTM B 6063 T5 for extrusions, sheet and plate.

Aluminum Base	ASTM 6063T5
Aluminum Plate:	ASTM 6063 T5, 5052

b. Protect aluminum surfaces to be placed in contact with cementitious materials with a protective coating.

c. Joints 2 Inches Wide and Less: Withstand plus or minus 35 percent movement of the joint width without failure.

d. Joints Greater Than 2 Inches: Withstand plus or minus 50 percent movement of the joint width without failure.

e. Water Barrier: Flexible EPDM.

f. Accessories: Manufacturer's standard anchors, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesive with low volatile organic compounds (Low VOC), and other accessories compatible with material in contact, as indicated or required for complete installations.

1507.4 Fabrications

a. Fabricate all expansion and seismic joint cover assemblies as detailed. Provide centering bars, sealing washers, gaskets, splice covers, and closures as necessary for complete installation.

- Fabricate special transitions and corner fittings as required.
- Miter and weld joint systems as applicable.
- Provide necessary and related parts, devices, water barrier, anchors, form clips and other items required for water-resistant.
- Provide corners, tees, transitions, curb risers, etc. assembled with connection mitered/interlocking and secured to ensure proper fit and alignment as applicable.

b. Shop assembles components and package with anchors and fittings. Provide components in single lengths where possible; minimize site splicing.

1508 Warranty

The Contractor shall submit the manufacturer's warranty that the materials furnished will perform as specified for a period of not less than five (5) year when installed in accordance with manufacturer's recommendation.

1509 Execution

1509.1 General

All materials and structural components subject to processing instructions of manufacturers shall be processed in accordance with such instructions.

Prior to the start of its installation under this sub-chapter, the Contractor shall verify that all conditions are suitable for the timely and effective carrying out of its work. Where unsuitable conditions are found, they shall be reported in writing to the engineer and under the engineer's direction immediately corrected.

1509.2 Examination

a. Verify that field measurements and block out dimensions are as shown on shop drawings prior to releasing materials for fabrication by the manufacturer.

b. Installer shall examine conditions under which work is to be performed and shall notify the contractor in writing of unsatisfactory conditions. Installer shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1509.3 Preparation

a. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for phases of Work, including preparing substrate, applying materials, and protecting installed units.

b. Coordinate and furnish anchorages, setting drawings, templates, and instructions for installation of expansion joint cover assemblies to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting in of frames.

c. Fastening to in Place Construction: Provide anchorage devices and fasteners where necessary to secure expansion joint cover assemblies to in place construction, including threaded fasteners with drilled in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.

1509.4 Installation

a. Installation shall meet or exceed all applicable referenced standards and conform to codes and ordinances of authorities having jurisdiction.

b. All installation shall be in accordance with manufacturer's published recommendations to the satisfaction of the engineer.

c. Perform cutting, drilling, and fitting required to install expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling. Set floor covers at elevations to be flush with adjacent finished floor materials. Locate wall, ceiling, roof, and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with required accessories.

d. Maintain continuity of expansion joint cover assemblies with a minimum number of end joints and align metal members mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials (if any) to frames with adhesive or pressure sensitive tape as recommended by manufacturer.

1509.5 Adjusting, Cleaning and Protection

a. Adjust joint cover to freely accommodate joint movement.

b. Protect the installation from damage by work of other Sections. Where required, remove and store cover plates and install temporary protection over joints. Re-install cover plates prior to Substantial Completion of work.

c. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's instructions.

1510 Joint Cover Schedule

Types and sizes of Expansion and Seismic Joints shall be as shown in the drawings and Bills of Quantities.

1511 Measurement

Measurement of works will be made as specified in the BOQ.

1512 Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all material, transportation, labor, equipment, accessories, installation, testing, commissioning and incidentals required to complete the respective work as specified.

1600 MISCELLANEOUS WORKS

1600. Coloured CGI Roofing

a. General

The corrugated iron sheet shall be of the specified gauge. A 24 B.G. sheet shall weigh 5.4kg/m². The sheet shall be free from rust and the zinc covering at the time of fixing shall be on perfect condition. Each sheet shall have 10 corrugations 75mm wide and 19mm deep with overall flat width of 800mm, referred to as 24 B.G. 10/3 sheets.

b. Laying and Fixing

Each sheet shall be laid on wooden or steel purling with an end overlap of 150 mm minimum or as per drawing and side overlap of two and half corrugations. The sheet shall be joined together with galvanized hook-bolts of L type of 8mm diameter, with bitumen and limpet washers. L hook shall be fixed at 300 mm interval along bearer and 600 mm along edge. Each bolt shall have "limpet" dome washer in addition to bitumen washer.

Wind ties of 40mm x 6mm flat iron shall be fixed at the eaves ends of the sheets fixing the same with purling by L hook bolts at 1200mm center to center distance.

c. Ridges and Hips

Ridge and hips shall be covered by special ridges and shall be bolted with 300mm lap on either side so as to prevent the rain driving under it.

Holes in sheets shall be made on the ground; the sheets shall be placed on trestles and holes punched in the ridge of corrugations from below upward. Unnecessary holes made on the roof shall be rejected in total.

d. Measurement

Measurement of works for CGI Sheet will be made in m² and the Ridge will be made in rm of works as specified.

e. Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, hardware, accessories, equipment and other incidentals to complete the works as specified.

1601. Gutters

a. General

Gutter shall be fabricated from plain G.S. Sheets of thickness as specified in the item. Eaves gutters shall be of the shape and section specified in the description of the item. The overall width of the sheet referred to therein shall mean the peripheral width of the gutter including the rounded edges. The longitudinal edges shall be turned back to the extent of 12 mm and beaten to form a rounded edge. The ends of the sheets at junctions of pieces shall be hooked into each other and beaten flush to avoid leakage.

Gutter shall be laid with a minimum slope of 1 in 120.

b. Laying and Fixing

Gutter shall be supported on and fixed to M.S. flat iron brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1.20 meters.

The gutter shall be fixed to the brackets with 2 Nos. G.I. bolts and nuts 6 mm diameter, each fitted with a pair of G.I. and bitumen washers. The connecting bolts shall be above the water line of the gutters. For connection to down take pipes, a proper drop end or funnel shaped connecting piece shall be made out of G.S. sheet of the same thickness as the gutter and riveted to the gutter, the other end tailing into the socket of the rain-water pipe. Wherever necessary stop ends, angles etc., should be provided.

The gutters when fixed shall be true to line and slope and shall be leak proof.

c. Measurement

Measurement of works will be made in rm. of works as specified.

d. Payment

Payment for work will be made on the basis of contract unit price indicated in the BOQ. The payment will be full and final compensation for all material, transportation, labor, hardware, accessories, equipment and other incidentals to complete the works as specified.

1602. Geotextile membrane

A geotextile membrane is a construction product used in ground and drainage projects. It helps with stabilization, filtration, separation, weed suppression and is a necessary addition to French drains and Soak away systems. Providing and fixing Geotextile membrane works are to be done as per drawing. Geotextile membrane shall conform to IRC SP 59: 2019.

Geotextile Membrane are used around the pipe of weep hole of Retaining wall to retain the soil and pass the water collected so that the pipes do not get blocked due to debris and laid as per design, drawings, and instructions of the site engineer all complete.

a. Measurement

The above work shall be measured in square meter (Sq. m.) as specified.

b. Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

1603. HDPE Pipes

HDPE pipe is a type of flexible plastic pipe used to transfer fluids and gases. Constructed from the thermoplastic HDPE (high-density polyethylene), it has low permeability and robust molecular bonding, making it suitable for high-pressure pipelines. HDPE pipe is often used for water mains, gas mains, sewer mains, slurry transfer lines, rural irrigation, fire-suppression system supply lines, electrical and communication conduits, and storm water and drainage pipes.

HDPE pipes shall conform to IS: 4984/72. The high density polyethylene shall be of medium quality and of wall thickness conforming to a working pressure of 6 kg/sq cm. the pipes shall be manufactured using virgin GM 5010 T2 raw materials as manufactured by Nepal polythene and plastic industrial or their equivalents.

Fitting shall high density polythene pipe of series II, made at site their form shall be true to shape, smooth and cylindrical, their inner and outer surface being a far as practicable concentric. These shall be sound and cast so as to be free from cracks, pin holes or other imperfections.

The floor traps and other such HCI fittings indicated in the schedule are to be jointed with the HDP pipes after being heated so as to cause the required expansion and laid in position.

Jointing, laying and testing shall be as per the manufacturer's specifications.

Pipes shall be of color specified by the engineer. Fitting for P.V.C. pipes shall include couplings, tees, bends, elbows, unions, reducers, nipples, and plugs. Outlets of suitable diameter for connection to the appliance shall be provided. P.V.C. pipes shall be jointed with P.V.C. pipes shall be done in the best workmanship.

No joints shall be covered until these are checked and tested by the engineer. Inlet and outlet levels of the soil pipes, waste pipes line shall be strictly followed (peg marking to be approved). Fitting where specified as HCL shall be used, and no alternative HDP fabricated shall be used unless specifically approved by the resident engineer.

The contractor shall ensure that only workman experienced in HDP pipe work are used. The resident engineer shall reject any and all works found to be not up to the standards required and request replacement of workman if found necessary.

All HDPE pipes and fittings shall be manufactured by a quality assured manufacturer. The material shall have a minimum required strength (MRS) value of 10 MPa. The pipes and fittings shall be colored blue (potable water), yellow (gas) or black (wastewater) and be suitable for below-ground use. The blue striped black pipes shall not be accepted as potable water pipes.

Gravity pipes shall be engineered light weight pipes with ring stiffness larger than SN 8kN/m2. Pressure pipes shall be in pressure class PN6 at least but shall be proper with the related design.

The diameter high density polethene pipe (1.703 Avg. wt. kg/m) diameter shall be 100mm staggered at 1m c\c in retaining wall all complete as per drawing, instruction and approval of engineer.

a. Measurement

The above work shall be measured in running meter (Rm.) as specified.

b. Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

1604. Stainless Steel Pipe Railing

2010.1 Material

Providing and fixing stainless steel hand rail works are to be done as per drawing. Stainless steel hand rails shall conform to ISI and must have a minimum of 13 to 14 percent of chromium to give strong, tough, and corrosion resistant and withstand ordinary atmospheric conditions.

Most of such steels shall be welded by either the electric process or by the oxy-acetylene method.

The finished surface of stainless steel should be free from all scales, pits and cracks.

The stainless steel pipe railing shall be with 50 mm diameter stainless steel pipe handrail with 3 rows of 25mm diameter stainless steel pipe in between handrail and floor and 50 mm diameter stainless steel pipe for vertical post @ 2m. c/c including welding, cutting, finishing all complete as per design, drawings and approval of site Engineer.

2010.2 Construction Procedures

The stainless steel pipes shall be made according to pattern given as per drawing. The railings system shall be permanently anchored. The fabricate rails and post shall be of size as shown in the drawing. The contractor shall use stainless steel elbows, tees, splice-connections, end caps etc. by welding where ever necessary. Remove burrs from all exposed cut edges. Close exposed ends of pipe and tubing by welding metal closure in place or by use of pre cased fittings. For posts set in concrete, furnish matching sleeves or inserts not less than 5 in. (127 mm). The welding shall be full and clean. All welded areas on stainless steel railing systems shall be ground and finished to blend with adjacent areas. Fabricate joints which will be exposed to the weather so as to exclude water, or provide weep holes where water may accumulate. If the expected discoloration, due to welding, of anodized aluminum and the resulting color discrepancies are not acceptable, they shall be touched up using an acceptable lacquer.

Provide holes, pre-set sleeves, or inserts of sufficient depth in concrete to develop required post strength. Clean dust and foreign matter from sleeves. Moisten interior of holes and surrounding surfaces with clean water. Place posts in position and brace until grout sets. Pour mixture into annular space until it overflows the hole. Set posts plumb and aligned. Set rails horizontal or parallel to rake of steps or ramp as shown in the drawing.

As installation is completed, wash thoroughly using clean water and soap; rinse with clean water. Do not use acid solution, steel wool or other harsh abrasives. If stain remains after washing, remove finish and restore in accordance with fabricator's recommendations. Protective wrappings shall not be removed until items are no longer subject to subsequent construction damage, at which time any necessary cleaning shall be performed.

2010.3 Testing and Inspection

The erected handrails, balustrade, railing and grab bar shall be straight without sagging.

2010.4 Measurement

The above work shall be measured in running meter (rm) as specified.

2010.5 Payment

Payment for the work will be made on the basis of contract unit price indicated in the BOQ.

The payment will be full and final compensation for all transportation, material, labor, accessories, painting and equipment to complete the works as specified.

1700 SANITARY, PLUMBING AND WATER SUPPLY WORKS

1701 Scope

This scope of work shall cover materials and workmanship required for the construction of internal and external water supply, soil, waste, vent, rain water system, installation of toilet fixture, sanitary and drainage system. Work under this section shall consist of furnishing all labor materials necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories required by the drawings and specified hereinafter or given in the schedule of quantities. The Contractor shall furnish all materials, labour and related items necessary to complete the work indicated on the Drawings and Specified herein

Without restricting to the generality of the foregoing the sanitary fixtures shall include all sanitary fixtures, CP fittings and accessories necessary and required for the buildings. Whether specifically mentioned or not, all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required. All exposed pipes within toilets and near fixtures shall be chromium plated unless otherwise specified.

Work for the water supply and sanitary consists of furnishing all labor, materials, equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the schedule of quantities.

Without restricting to the generality of the foregoing, the water supply system shall include the following:

a) Connecting the mains supply to the designed tanks as per the drawings.

b) Control valve, masonry chambers and other appurtenances.

c) Connections to all plumbing fixtures, pantries and overhead tanks.

d) Excavation and refilling of pipe trenches.

e) Pipe protection and painting.

Drainage lines shall be laid to the required gradients and profiles as directed by the Consultant. All drainage connections work shall conform to the local municipal bye-laws. All slopes and run off shall conform to the best standard of the IS Hydraulic engineering practices. The minimum bed slope for drainage works should be 1.5% unless otherwise directed by the consultant.

The Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority as shall be required by local ordinances. Location of all manholes, catch basins, etc, shall be confirmed by the Consultant before the actual execution of the work at site. All works shall be executed as directed by the Consultant and subject to the final approval of the Consultant.

Without restricting to the generality of the foregoing, the drainage system shall include:

Sewer lines including excavations, pipe lines, manholes, drop connections, underground storm water drains, including pipes, manholes, catch basins, open drains and culverts.

1702 Reference Document

a) In case where the specification given is found to be inadequate, latest IS or NS specification shall hold good. Whether reference has been made to IS or NS the same shall refer to the latest specification mentioned in the section. If type is not specified elsewhere the type of material and fixture shall be as directed by consultant. If any ambiguity or missed items, the same shall be decided by the client in consultation with the consultancy.

b) All materials shall be best of their kind and shall conformed to the latest IS or NS standards.

c) All samples shall be approved by consultant regarding its quality as specified, prior to the procurement by the contractor. Each sample shall be accompanied by the manufacturer's specification, brochures, test certificates and guarantee statements for approval.

d) All sets of specimen sample of approved materials shall be kept at Site Office by the contractor.

e) The workmanship shall be the best of its kind and shall conform to the specification of IS or NS standard in every respect or latest trade practice. All defective or unsuitable materials and/or workmanship shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship by the contractor in his own cost.

f) Available Codes

Unless specifically mentioned otherwise, all the applicable codes and the standards shall be as the standard published by the Bureau of Indian Standard (IS) or Nepal Bureau of Standard (NS) and its subsequent revision in respect of design workmanship, quality and properties of materials and method of testing.

Some of these available Standards are listed below:

Code	Subject
IS:778 - 1964	Specification for gunmetal gate, globe and check valves for water, steam and oil only.
IS:1172-1971	Basic requirement of water supply, drainage and sanitation.
IS:1239-1982	Specification for M.S. or G.I. pipes
IS:2065-1983	Code of practice of water supply in buildings
IS:4985-2000	Specification for uPVC soil, waste and ventilating pipe and accessories
IS:1729-1974	Specification for cast iron manhole covers and frames
IS:1742-1983	Code of practice for building drainage
IS:2064-1973	Code of practice for selection, installation and maintenance of sanitary appliances
SP 35(1987)	Handbook on Water Supply and Drainage
IS: 2064 (2002)	Selection, Installation and Maintenance of Sanitary Appliances
NBC 208: 2003	Nepal National Building Code, Sanitary and Plumbing Design Requirements
IS: 15778-2007	Chlorinated polyvinyl chloride (CPVC) pipes

1703 Related Work

The Contractor shall become familiar with other Divisions of the specifications affecting work of this trade.

1704 General Requirement

The scope of work covered by this Chapter shall be deemed to comprise the furnishing and installation of all cold and hot water supply pipe work, soil, waste, rain and vent pipe work, vitreous china sanitary ware, CP fixtures etc. as shown on plans and as specified. It shall also include the supply of the appertaining materials and parts, scaffolding, off-loading on site and all operations in connection with civil works, unless otherwise specified in the Bills of Quantities.

Materials and parts, which the Contractor shall supply and install, shall be new and unused. They shall comply with the regulations regarding quality and dimensions. Materials and parts that are not standardised shall be used only with the approval of the Engineer.

The materials shall be protected from rain and inclement weather all to the satisfaction of the Engineer. The cost of covering materials shall be deemed to be included in the unit prices for the brickwork and masonry.

1705 Samples/Submittals

Representative samples to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept with the Engineer for future reference and comparison. All materials supplied shall conform to these approved samples in all respects.

1706 Basic Materials and Method

All materials provided for the contract will be in strict accordance with the latest version of the applicable Indian Standards. All manufacturer's data, specifications and relative information together with samples will be submitted to the Engineer or Site In-charge for approval prior to being purchased, otherwise at the contractor's own risk.

Sanitary fixtures shall be of the best quality approved by the Consultant. Wherever particular makes are mentioned, the choice of selection shall remain with the Consultant. The water supply and sanitary works are to be laid to alignments and grades shown on the drawings but subject to such modifications shall be as instructed by the consultant from time to time to meet the requirements of the work. All water supply and sanitary pipes, fittings, fixtures and appurtenances which are to be embedded into concrete, masonry, earth or any construction works shall be embedding only after approval of consultant. All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned in the schedule of quantities, specifications or drawings or not.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Consultant's/interior designer's requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern desired. Fixing screws shall be half round head chromium plated brass screws with CP washers wherever required as per directions of Consultant. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level at heights shown on drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor.

All CI brackets, fitting clamps and shall be painted with one coat of approved primer and 2 coats of Black Japan paint. All painting works shall be carried out to full satisfaction of the consultant. If directed, additional coats of paints shall be applied to get uniform and matching finish without any extra cost. In case of non-availability of specified sized fixtures in specified units the nearest size in FPS or Metric units shall be provided with prior approval of the consultant for which neither extra will be paid nor shall any rebate be recovered.

Wherever the word 'approved' is used it shall mean approved by the consultant.

Prior to casting any RCC structure the contractor shall put necessary sleeves through beam, slab and other structure to make easy water, waste and soil lines passing through the particular structure. At the proper elevations to give the desired slopes needed to meet the recognized standards for drainage.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections. As far as possible all bends shall be formed by means of hydraulic pipe bending machine for pipes up to 65mm dia. in case of GI/MS pipes.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc. Pipes shall be securely leveled to the required slopes &fixed to walls and ceilings by suitable clamps at intervals specified. Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

The rates quoted shall be for complete items as fixed in position and cover all costs of materials, labor, tools, equipment, supervision, cutting of holes, chases etc., excavation and satisfactory backfill in any type of soil, and also for providing fixing arrangements such as clamps, brackets, blocks etc. The rate shall also include restoration to original condition. All debris from demolishing shall be removed without any extra charge. Work shall be planned in such a manner that demolition and chipping are held to the very minimum. This form of installation shall not be recognized as the "norm" and if the consultant determines that excessive retro-fitting is being done he may instruct the contractor to remove sections and accomplish the work and replace the removed work at his (contractor's) expense.

Tenders shall be based upon complete installations. Products required which are not shown or mentioned, or not specified herein as to manufacturer, quality, etc. shall be furnished of the highest quality (commercial standard).

Materials shall be new and free from all defects.

All materials, apparatus or equipment called for on the Plans or in the Specifications by trade names, or the name of a particular manufacturer, or by catalogue reference are the materials, apparatus, or equipment which should be allowed for in the Tender, or qualification submitted at the time of Tender submission.

The work shall be carried out in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction. All changes and alterations required by an authorized inspector of any authority having jurisdiction shall be carried out at no cost to the employer.

1707 Materials Trade Names Variations

Tenders shall be based upon complete installations. Products required which are not shown or mentioned, or not specified herein as to manufacturer; quality, etc. shall be furnished of the highest quality. Materials shall be new and free from all defects. All materials, apparatus or equipment called for on the plans or in the specifications by trade names, or the name of a particular manufacturer, or by catalogue reference are the materials, apparatus, or equipment which should be allowed for in the Tender, or qualification submitted at the time of Tender submission.

1708 Regulations

The work shall be carried out in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction. All changes and alterations required by an authorized inspector of any authority having jurisdiction should be carried out at no cost to the Owner.

1709 Drawings and Specifications

These specifications shall be considered as an integral part of the drawings, which accompany them. Neither the plans nor the specifications shall be used alone. Any item or subject omitted from one, but which is mentioned or reasonably implied in the other shall be considered as properly and sufficiently specified and therefore must be supplied by the contractor. Misinterpretation of any requirements of either the drawings or specifications shall not relieve the contractor of his responsibility for properly completing his work.

The contractor shall apply to the Engineer or Site In-charge for any explanation, which he may require in regard to the meaning and intent of any clause in the specification and contract. He shall be held responsible for any errors or losses consequent upon failure to obtain such explanation. The contractor shall consult with the Engineer or Site In-charge to obtain detail drawings or instructions for exact location of equipment as work progresses, before installing fitting or equipment and will be responsible for coordination with all other work trades including finishes.

Drawings show general location and routes to be followed by pipes, ducts, etc. where not shown, or shown diagrammatically, the contractor shall install them in accordance with best trade practices.

1710 Shop Drawings

The contractor shall submit to the Engineer or Site In-charge all shop and setting out drawings or diagrams necessary in order to make clear the work intended or to show its relation to adjacent work of other trades. The contractor shall make any changes in such drawings or diagrams, which the Engineer or Site In-charge may require, consistent with the contract. Details of shop drawings submitted for approval shall show clearly the relations of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made by the contractor and noted on the drawings before being submitted for approval.

1711 As Built Drawings

The Contractor shall submit As Built Drawings in soft copy and print, within 30 (thirty) days of the issuance of the Letter of Completion.

"As Built" records shall be retained in the site office and kept up to date daily in regard to changes in actual installation from the Plans and Specifications. Alterations to duct work, piping services, etc. shall be noted and the revised arrangement drawn in accurately, complete with dimensions from column lines. Every precaution shall be taken to protect the Drawings from damage and loss.

The" As Built" records shall be made available to the Engineer upon request and made available at each site meeting. After no further alteration can be expected and the Contract is nearing completion, the records shall be submitted for final approval.

The Contractor shall include on "As Built" records the dimensions, location of all buried piping and valves, and during construction plainly mark location of exterior services and valves to prevent damage to these until the Project is completed.

The contractor shall submit as built drawings of all water supplies, rain, waste and soil lines and installations based upon actual construction to consultant after completion and before handover of the project at his own cost.

1712 Water Supply

1712.1 Scope

The work shall cover all materials required for such pipes and fittings, clamps, long screws etc. The work shall include water supply external and internal, including line marking, jointing the pipes, fixing in position, paintings, excavation, groove cutting and reinstating to its original finish complete with testing and ready for operation.

Work under this section consists of furnishing all labour, materials, equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the schedule of quantities. Without restricting to the generality of the foregoing, the water supply system shall include the following:

- Connecting the mains supply to the designed tanks as per the drawings.
- Control valve, masonry chambers and other appurtenances.
- Connections to all plumbing fixtures, pantries and overhead tanks.
- Excavation and refilling of pipe trenches.
- Pipe protection and painting

1712.2 General Requirements

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner. Short or long bends shall be used on all main pipelines as far as possible. If HDPE, PPR, PVC, CPVC, multilayer pipes are used then methods approved by the manufacturer shall be used. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc. Pipes shall be securely levelled to the required slopes & fixed to walls and ceilings by suitable clamps at intervals specified. Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

1712.3 CPVC pipe for cold water

All CPVC Schedule 40 and schedule 80 pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be produced in Nepal or India using domestic materials, by an ISO 9001 certified manufacturer, and shall be stored indoors after production, at the manufacturing site, until shipped from factory. This pipe shall carry the Nepal Standard or Indian Standard seal.

Chlorinated Polyvinyl Chloride (CPVC) water supply Pipes should be of standard dimensional ratios SDR 11(class 1). All CPVC Pipes and Fittings should be made from identical CPVC compounds having the same physical properties. Pipes and fittings should be product of SDR 11 meet the requirement of ASTM D 2846, specific to Copper Tube Size dimension.

Pipe	Temperature (0C)	Pressure Rating(kg/sq cm)
SDR 11	27	27.6
	82	6.8

The joints should be same of ASTM F-493 Solvent Cement Application. Horizontal and vertical pipes should be supported by pipe clamps or by hangers not less than 75 cm and as per requirements. Threaded CPVC fittings with tapered pipe threads should be used with a suitable thread sealant to ensure leak proof joints. The diameter and thickness corresponding as tabulated below.

Nominal Size(mm)	OD (mm)	Wall thickness (mm)
15	15.9	1.73
20	22.2	2.00
25	28.6	2.60
32	34.9	3.20

40	43.3	3.80
50	54	4.90

The joint of pipes and fitting shall be either threaded joint or solvent cement joint as directed in above codes.

Complete installation of CPVC pipes include supply of pipes and necessary fittings such as Tees, Bends, Reducers, Crosses, Unions, socket, elbow,

crossover, transition piece, transition joint, end cap, clamp etc. with both male and female of respective fittings, chasing in wall or floor and repair to original finish, laying and jointing of pipes and fittings and pressure testing.

All water supply CPVC pipes, fittings and valves shall be tested by hydrostatic pressure of at least 10 kg/cm2. Pressure shall be maintained for a period of at least 24 hours without appreciable drop in the pressure.

In addition to the testing carried out during the construction, the Contractor shall test the entire installation after connections to the plumbing systems. The Contractor shall rectify all leakage, and shall replace all defective materials in the system.

After commissioning of the water supply system, the contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. The valves, which do not operate effectively, shall be replaced by new ones at the Contractor's cost and tested as above. Upon completion of all the test and necessary replacements, all water piping shall be disinfected as below:

After thoroughly flushing the system with clean water, the system shall be filled with a measured quantity of sodium hypo chloride solution to the water to give free residual chlorine of 5 mg/1itre. After 1 hour of retention, the system shall be drained, re-flushed and returned to service.

Measurement

Measurement for the Contract Item CPVC pipes will be made per running meter of complete installation. The rate shall include for all labor and materials required. The measurement shall be done for running meters, fittings etc. not payable separately.

1712.4 Clamps

CPVC pipes in shafts and other locations shall be supported by MS clamps of design approved by Engineer. Pipes at ceiling level shall be supported on structural clamps fabricated on MS structural brackets as described in relevant sections of this specification. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

Unions

The Contractor shall provide adequate numbers of unions/flanges on all pipes to enable dismantling later. Unions shall be provided near each gunmetal valve, stop cocks or check valves and on straight runs as necessary at appropriate locations and required and/or directed by the Engineer.

1712.5 Gate, Globe, and Check Valves

Stop Valves shall be gunmetal wedge gate valves, rising stem, hand-wheel operated with screwed female ends: conforming to IS 778-1984 Class 1 or equivalent. Valves 65mm dia. and below shall be heavy gunmetal full-way valves or globe valves conforming to IS 778-1971 class I. Valves shall be tested at the manufacturers with test results and their name stamped on it. The Engineer shall approve all valves before they are allowed to be used in the works. For the cold and hot water distribution pipe lines unless otherwise specified by the engineer, the contractor shall use the valves and pipes of same brand, preferably from same manufacturer.

1712.6 Air valves

Air valves shall be provided at all high points in the system. Each air valves shall be isolated by a c. I. double flanged sluice valves. Air valves shall be of approved make conforming to Indian standard. The valve shall conform IS14845 (2000).

1712.7 Scour valves

Scour valves shall be provided at all low points in the system. Each air valve shall be isolated by a c. I. double flanged sluice valves as specified and discharged into the nearest storm water drains.

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1712.8 Ball valves

Ball valves shall be of brass with float of copper sheet 0.58 mm. thick for float up to 115 mm size. The body of the valves shall withstand pressure of 14kg/sq m. and shall conform to I.S: 1708-1962.

1712.9 Pressure Reducing Valves

The Water Pressure Reducing Valve shall be installed to reduce static and flowing pressures in water distribution systems. The unit shall be a diaphragm/balanced piston type with integral stainless steel strainer and a built-in bypass to relieve pressure build-up downstream of the assembly. The valve shall be spring loaded to open and shall be diaphragm actuated to close under pressure conditions. The valve shall be suitable for supply pressure up to 400 psig and water temperatures from 33° to 180°F. The valve's internal parts such as the cartridge assembly, strainer, diaphragm, and spring shall be accessible for inspection, repair or replacement without disconnecting the device from the pipeline. In addition, the valve shall have a clean-out feature to allow for removal of the strainer and seat disc without disturbing the pressure setting. It shall meet the requirements of the following standards:

- Materials: Invest Cast Stainless Steel Materials
- Pressure Setting and Flow Rate of Direct – Activated Pressure Reducing Valve
- Direct – Activated Pressure Reducing Valve Directly Opens and Close Valve gate by the outlet Pressure.
- When outlet pressure is under setting pressure, Valve gate automatically opens, to make valve gate fully open, Adjustable pressure range and setting pressure are relative points.

The PRV shall be of AIRA brand of high pressure range that can allow minimum 40 kg/sqcm water head at inlet and outlet can be adjusted to 20 kg/sq.cm water head or equivalent.

1712.10 Brass Fittings

All brass stop cocks and bib cocks shall be heavy type bright finished with renewable leather washers conforming to I.S. 781-1967. The weight shall be as follows:

Diameter (mm)	Stop Cock (kg)	Bib Cock(kg)
15	0.40	0.40
20	0.75	0.75
25	1.30	1.25

1712.11 Plastic Tank

The tanks shall be vertical or horizontal type as required and of One Piece Molded (without any seam, joints or weld) High Density Polyethylene. The tank shall be provided with a manhole of size 400 mm in diameter. The tanks shall be of Hill take, Roof top or equivalent.

HDPE overhead water tank shall be of Hilltake (heavy duty) or equivalent conforming to NS 353 of specified capacity. It shall be fixed on 300mm height brick masonry bed on the terrace level. The tank shall be fitted with inlet, outlet, overflow, washout and vent pipe as recommended by manufacturers and instruction.

Tanks of the size and capacity described in the Bill of Quantities shall be of the best quality available and shall be manufactured by SyntexPlast Containers by the Bharat Vijay Mills Ltd, N Gujarat of their "Syntex" range, Hilltake by Hilltake Pvt. Ltd. Nepal or equivalent. They shall conform to the manufacturer's specifications to all connections etc, to be made to the tanks. They shall be free of all defects.

Contractor shall provide inlets, outlets, and overflow pipes, socket for float level switch and inter connection. The overflow and vent pipes shall be provided with a mosquito proof brass net. The vent pipes of size mentioned shall be provided with bends and pieces of pipes facing downward. The holes in the tanks for the inlets, outlets, overflows, etc. shall be made as per the manufacturer's specifications.

All outlets connections shall be at least one size higher than the pipe connections and shall be connected to the pipes by reducers (no reducing bushes will be accepted).

1712.12 Support for Overhead Water Storage Tanks

The tanks where required shall be on the roof top over an elevated RCC platform other structural members as shown on the Drawing. The tanks shall be put in such a manner that the bottoms of all the tanks have a sufficient bearing. The Contractor shall provide all supporting and fixing devices (such as mild steel ring around the tanks with anchoring members) necessary to fix the tanks and fitting securely in position as per the manufacturer's Specifications. The fixing devices shall be rigidly anchored into the building structure. All the devices shall be rust proof and shall be so fixed that they do not present any unsightly look.

1713 Soil, Waste, Vent and Rain Water Pipes

1713.1 Scope

Work under this section shall consist of furnishing all labour, materials, equipment and applications, necessary and required to completely install all soil, waste, vent and rain water pipes as required by the drawings, specified hereinafter and given in the Bill of Quantities. Without being restricted to the generality of the foregoing, the soil waste and vent pipes system shall include:

- Vertical and horizontal soil wastes and vents pipes, rain water pipes and fittings, joints, clamps and connections to fixtures.
- Connection of all pipes to sewer and storm water lines as shown on the drawings at ground floor levels.
- Floor and urinal traps, clean-out plugs and inlet fittings.
- Waste pipe connection from all fixtures e.g. Washbasins, sinks, urinals, kitchen, equipment and plant room equipment.

1713.2 General Requirements

All materials shall be of the best quality conforming to the specifications and subject to the approval of the Engineer. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.Fitting positions shall in all cases line up with & conform to access panels for ease of maintenance. Pipes shall be securely fixed to walls by suitable clamps at intervals specified. Access doors for fittings and clean-outs shall be so located that they are easily accessible for repair and maintenance. All work shall be executed as directed by the Engineer.

1713.3 PVC Pipes and Fittings: Soil, Waste and Vent Pipes

Where specified, soil, waste, vent and rain water pipes shall be confirmed to IS 4985: 1981 of 4 kg/cm2 and 6 kg/cm2 as specified in BOQ. uPVC pipe should have length of 3m or 6m with molded. Fittings for uPVC pips shall be of thickness not less than 3.2mm. Pipe color shall be as specified by the consultant.

Before use at site, all pipes shall be tested by filling up with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blowholes and cracks. All defective pipes shall be rejected and removed form the site.

Pipes shall be further tested after installation by filling up the stack with water as per manufacturer's specification. All opening and connections shall be suitably plugged. Any joint found leaking shall be re-laid and joined. All pipes shall be fixed in gradient towards the outfall drain. Pipes inside toilets shall be concealed or otherwise as per drawings and instruction. uPVC pipe lines through basement ceiling shall be clamped as per drawings and instruction.

Complete installation of uPVC pipes include supply of pipes and necessary fittings such as Tees, Bends (with or without door), single and double Y (with or without door), Reducers, Crosses, Couplers, Solvent cement, NC putting, rubber, rings, clip etc. It also includes trench excavation in any type of soil and backfilling with proper compaction, chasing in wall or floor and repair to original finish, laying and jointing and pressure testing.

The buried pipe shall be bedded with a soil free from rock or sharp edged objects (preferably sand) with a minimum of 75 mm at all sides.

Measurement:

Measurement for uPVC Pipes will be made per running meter of complete installation.

1713.4 ASTRAL uPVC Foam core Pipes & ASTRAL uPVC DWV

Providing, fixing, testing and commissioning ASTRAL uPVC Foam core Pipes & ASTRAL uPVC DWV Click Ring type fittings for drain, waste and vent including injection moulded fittings e.g. tees, bends, clamps, Y junctions, reduces couplings, adapters, door bend and terminal cowl etc. jointing with lubricant/rubber ring/ solvent cement including cuttings the walls and floor as required and making good the walls and floors as required at site for internal drainage system. Installation to be made with proper anchoring, fasteners, clamps, etc and shall be to the satisfaction of the Engineer-In-Charge.

PVC Pipes shall be measured along the centre line of pipes and fittings in running meter between socket to socket or bend,tee of pipes, Elbow, Yee or similar fittings.

1713.5 UPVC Pipes

All Soil, waste, vent and rain water pipes shall be unplastisized rigid Poly Vinyl Chloride (UPVC) pipes conforming to IS 4989-1958. Pipes shall be of following specifications:

Normal diameter (mm)	Working pressure (kgf/cm2)
50	6
75	4
110	4
160	4

Pipes shall be of colour specified by the Engineer. Fitting for UPVC pipes shall include couplings tees, bends, elbows, unions, reducers, nipples and plugs. Outlets of suitable diameter for connection to the appliance shall be provided. Contractor shall use pipes and fittings of matching specifications. Fittings shall be of the required degree of curvature with or without access door. Access door shall be screw type with neoprene gaskets as shall be approved by the Engineer.

1713.6 Clamps

Holder bat clamps shall be of standard design and fabricated from M.S. flat 40 mm x 3 mm thick and 12 mm dia. rod and 6 mm nuts bolts. They shall be painted with two coats of black bitumen paint before fixing. Holder bat clamps shall be fixed in cement concrete of 1:2:4 mix.

Where holder bat clamps are to be fixed on RCC column, wall or beam they shall be fixed with 40mm x 3mm flat iron "U" type clamps with anchor fasteners of approved design. Rates for both types of clamps shall be the same and no addition or deduction shall be made.

Structural clamps shall be fabricated from MS structural members e.g., rods, angles, channels, flats as per detailed Drawing. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide.

1713.7 Pipe Supports and Hangers:-

Spacing for supports & hangers of fixing for internal piping shall be as given in the following table.

Kind of Pipe (mm)	Size of Pipe (mm)	Horizontal Run (m)	Vertical Run (m)
UPVC	50	2	2
	75	2.5	2.5
	100	2.5	2.5

1713.8 Waste Pipe from Appliances

Waste pipe from appliances e.g. wash basins, sinks, urinals, bath tubs, water coolers shall be of UPVC pipes with proprietary fixtures & fittings of the approved make conforming to all relevant ISS & also to IS 4984-1978. All pipes shall be fixed in gradient towards the out-falls of drain. Spacing for clamps for such pipes shall be as follows:

Kind of Pipe	Horizontal Run (m)	Vertical Run (m)
PVC Pipes	300 cm	240 cm

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HDPE Pipes	180 cm	120 cm

1714 Sanitary Wares

1714.1 Scope

Work under this section shall consist of furnishing all labour materials necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories required by the drawings and specified hereinafter or given in the schedule of quantities. Without restricting to the generality of the foregoing, the sanitary fixtures shall include all sanitary fixtures, CP fittings and accessories, etc, necessary and required for the buildings. Whether specifically mentioned or not, all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required. All exposed pipes within toilets and near fixtures shall be chromium-plated brass or copper unless otherwise specified. All hot water pipes shall be lagged & properly insulated from the hot water storage tanks to the hot water taps & outlets.

Sanitary ware, accessories and chrome plated CP fittings shall be of the best quality, as approved. Wherever particular quality is mentioned, the choice or selection shall remain with the consultant.

All fittings and fixtures shall be fixed in a neat workmanship manner to correct level at heights shown on Drawings, Instruction and in accordance with the manufacturer's recommendations.

1714.2 General Requirements

Sanitary fixtures shall be of the best quality approved by the Engineer. Wherever particular makes are mentioned, the choice of selection shall remain with him. All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned in the schedule of quantities, specifications or drawings or not. All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Engineer/interior designer's requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern desired. Fixing screws shall be half round head chromium plated brass screws with CP washers wherever required as per directions of Engineer. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level at heights shown on drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor.

1714.3 Commode and Water Closet

Commode and Water closet shall be of white vitreous or any other colour as specified with wash down flushing cistern and 100 mm diameter double symphonic close porcelain P or S trap without vent horn. The set shall be conforming to IS 2556. Commode shall be provided with Bakelite black heavy solid plastic seat cover and lid. WC shall be flushed by means of matching earthenware, ceramic cistern.

The WC shall be fixed in level in a neat workmanlike manner. The WC and trap shall be set in cement concrete 1:2:4 mix (1 cement 2 coarse sand 4 stone aggregate 20mm nominal size). Joints between WC and flush pipe shall be made with a putty of white lead and linseed oil and caulked well or with an approved rubber joint. A proper procedure of water proofing, water sealant shall be applied in order to prevent leakage.

Valve shall be of 12.7mm diameter CP brass with inlet connection of required length with union and CP brass cap.

Measurement:

Measurement for the commode and water closet shall be made per unit set of complete installation. Nothing extra shall be provided for the water proofing sealant, water proofing works that shall be carried out as per the instruction.

1714.4 White Glazed Wash Basin

Wall mounded and counter types wash basin shall be of white vitreous of first class quality conforming to IS 2556 and of specified size. Wash basin shall be fitted with the heavy CP bottle trap below.

Basins shall be supported on a pair of CI brackets of metal angles and channels cantilevering from wall face. All brackets shall be installed in such a way as to be hidden from view. They shall be provided & fixed in place early so that the built up vanity may be installed in sufficient time to comply

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with completion dates. Each basin shall be provided with 32mm dia CP waste with overflow, popup waste or rubber plug and chain 32mm dia CP brass bottle trap with CP pipe wall and flange as given in the schedule of quantities.

Each basin shall be provided with mixing fitting or pillar tap as specified in the Bill of Quantities and/or as approved by the Consultant. Basins shall be fixed at proper heights as shown on drawings. If heights is not specified, the rim level shall be 70cms or as directed by the Consultant.

Measurement:

Measurement for the white glazed wash basin shall be made per unit set of complete installation.

1714.5 Mixing Fittings

Mixing fittings shall be C.P. brass of approved quality with modern head for hot and cold for spray and rim with diverter.

Measurement:

Measurement for the mixing fittings shall be made per unit set of complete installation.

1714.6 Angle valve

Angle Valve shall be of 12.7mm dia. C.P. brass with C.P. cap and c.p. nipple .The connection between angle valve and supply line laid in chase shall be made in a manner so that the union is flush with finished face of the wall and no threaded portion of the angle valve or supply line is visible.

Measurement:

Measurement for the Angle Valve shall be made per unit set of complete installation.

1714.7 Sinks

Sinks shall be stainless steel as specified in the schedule of quantities. Each sink shall be provided with RS or CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 32 mm dia CP waste coupling with chain and rubber plug, 32mm dia. Bottle trap with clean out hole and plug 15mm dia CP Sink Cock. Fixing shall be done as directed by the consultant and shall be coordinated with the interior fit-out program. Supply fittings for the sinks shall be fittings of CP cock/mixer as specified.

Fixing of the sink: It shall be laid in wall in a workman like manner care being taken not to damage the sink in the process of fixing. If damaged in any way, it shall be replaced at no cost to the Employer. The sink shall be fixed on a proper base of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone ballast 20mm. nominal size) taking care that cushion is uniform and even without having any hollows between the concrete base and sink. Joining between the sink and wall shall be neatly done and no hair cracks shall be visible. Joining between the outlets of sink shall be made leak proof.

Measurement

Measurement shall be made per unit set of complete installation.

1714.8 Stainless Steel Scrub Sink/sluice/sterilization sink

Stainless Steel Scrub Sink, sluice, sterilization sink shall be of shape and type as specified in the Bill of Quantities. The scrub sink shall be fabricated from 16 SWG stainless steel as per bill of quantity. The sink shall be fitted with a 38mm waste coupling and joined to the wall drain pipe. The sink is fabricated by fabricator with the equivalent quality.

The sink is fixed to the wall with nickel-painted pan head screws and mild steel brackets as indicated in the drawings. The fittings shall be 15mm elbow-operated mixer or sensor of approved make.

1714.9 Flush Valves

CP flush valve shall be fitted to the urinal. The flush valve shall include 25mm diameter control cock and elbow set complete with adjustable sleeve and wall flange.

Measurement:

Measurement for the stainless flush valve shall be made per unit set of complete installation.

1714.10 Mirrors

Mirrors shall be of approved quality. All edges shall be rounded off. Mirrors shall be fixed to wall with brass chromium plated screws and washers. The approval shall be taken from the Engineer prior to installation.

Mirrors shall be electro-coated copper 5.5mm thick of guaranteed quality of float glass and reputed make. The size shall be as specified in the schedule of quantities & the drawings. The image shall be clear and without waviness at all angles of vision. Mirrors shall be provided with blacking of 12 mm thick marine plywood fixed with CP brass semi-round headed concealed screws and cup washers or CP brass clamps as specified or instructed by the Consultant.

Measurement

Measurement for the Mirror shall be made per unit set of complete installation.

1714.11 Towel Rails and Rings

Towel rails and rings shall be Jaguar quality of heavy duty CP brass with two brackets. The size of the rail shall be as specified. The brackets shall be firmly fastened by means of CP brass screws and nylon grip plugs firmly embedded in the wall.

Measurement

Measurement for the Towel Rail shall be made per unit set of complete installation.

1714.12 Robe Hook, Toilet Paper, and Soap Dish

Robe hook, toilet paper holder and soap dish shall be heavy grade Jaguar quality. All fixtures shall be fixed in a neat workmanship manner with CP brass screws, where required.

Measurement

Measurement for the robe hook, toilet paper holder and soap dray shall be made per unit set of complete installation.

1714.13 CP Fittings

All CP fittings sink tap, basin tap, bib cock, surgical valve, scrub/sink spout, basin mixer, shower mixer, shower rose, spray, flush valve, conceal stop valve, push flush cock and spreader etc. shall be Jaguar as specified in BOQ and approved by consultant The fittings shall be installed with necessary accessories at correct levels in a neat workmanship. All the CP fittings shall comply with IS 8931 (1993) or its latest revisions.

Measurement

Measurement for each CP fittings shall be made per unit set of complete individual installation.

1714.14 Multi Floor Trap and Gratings

Multi floor trap shall be made of uPVC Panchkanya or equivalent quality with water seal. The floor trap shall be covered with 3mm thick heavy CP brass grating. The floor finish around the trap shall be carefully executed by skilled workmanship to provide perfect finish with slope.

Measurement

Measurement for the multi floor trap and grating shall be made per unit set of complete installation.

1714.15 Gully Trap

Gully trap shall be made of uPVC Panchkanya or equivalent quality with water seal. Gully trap shall be installed to waste lines prior to waste manhole. The trap shall be carefully executed by skilled workmanship to provide perfect finish with slope.

Measurement

Measurement for the gully trap shall be made per unit set of complete installation.

1715 Outdoor Pipe Installations, Manhole, Septic Tank and Soak Pits

1715.1 GI pipes and fitting

The pipes shall be galvanized mild steel welded tubes and seamless, screwed and cockketted tubes conforming to the requirements of IS B 1239- 1958 for medium grade. Such pipes shall be 'B' class Indian tube company (ITC) and all fittings shall be of galvanized 'R' brand. These pipes shall be painted two coats with black japan outside before laying in position.

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Trenches shall be 450mm plus diameter of pipe with a minimum width of 450mm for pipes up to 50 mm dia. And 600mm for pipes above 50mm dia. Excavation, refilling and disposal of surplus earth shall be done in accordance with the specification for civil works.

1715.2 Anchor Blocks

Contractor shall provide anchor blocks at all bends, tee connections and other places as directed by the architect. These blocks shall be in cement concrete 1:2:4 of size as shown on the drawings.

1715.3 Valve chambers

All underground sluice valves, scour valves and fire hydrants shall be located in brick masonry chambers of size as given in the bill of quantities conforming to the drawings.

1715.4 Making connections to existing mains

Wherever required contractor shall make tee connections to existing water supply mains of required size. The contractor shall make adequate arrangements for cutting the roads where required and shall provide suitable road blocks with red signals and lanterns at night to prevent any mishap. He shall inform the concerned authorities of his intentions to shut off the water supply well in advance. He shall then excavate the pit of required size. Adequate arrangement for pumping and bailing out water shall be made. The connection shall be made by inserting the tee with a collar, of the required size. Notwithstanding the size of main pipe shown on the drawings and given in the bill of quantities, contractor must check the size of the main and obtain materials accordingly. A sluice valve shall be provided after the tee connection.

1715.5 HDPE /PVC Pipe System

HDPE pipes shall conform to IS: 4984/72. The high density polyethylene shall be of medium quality and of wall thickness conforming to a working pressure of 6 kg/sq cm. the pipes shall be manufactured using virgin GM 5010 T2 raw materials as manufactured by Nepal polythene and plastic industrial or their equivalents.

Fitting shall high density polythene pipe of series II, made at site there form shall be true to shape, smooth and cylindrical, their inner and outer surface being a far as practicable concentric. These shall be sound and cast so as to be free from cracks, pin holes or other imperfections.

The floor traps and other such HCI fittings indicated in the schedule are to be jointed with the HDP pipes after being heated so as to cause the required expansion and laid in position.

Jointing, laying and testing shall be as per the manufacturer's specifications.

Pipes shall be of color specified by the engineer. Fitting for P.V.C. pipes shall include couplings, tees, bends, elbows, unions, reducers, nipples, and plugs. Outlets of suitable diameter for connection to the appliance shall be provided. P.V.C. pipes shall be jointed with P.V.C. pipes shall be done in the best workmanship.

No joints shall be covered until these are checked and tested by the engineer. Inlet and outlet levels of the soil pipes, waste pipes line shall be strictly followed (peg marking to be approved). Fitting where specified as HCL shall be used, and no alternative HDP fabricated shall be used unless specifically approved by the resident engineer.

The contractor shall ensure that only workman experienced in HDP pipe work are used. The resident engineer shall reject any and all works found to be not up to the standards required and request replacement of workman if found necessary.

Measurement

P.V.C. / H.D.P. pipes shall be measured per running meter and include meter and include items as stated in the bill of quantities.

1715.6 Manholes

The internal size of manholes shall be of as specified in BOQ and depth depends upon gradient of waste or soil or rain water lines and wall thickness depending upon depth and site conditions. The RCC foundation, benching, wall, finishing, levels of inlet and outlet, cover with frame etc. for manholes shall be constructed as per drawing and instruction. The soil manhole shall not retain any night soil in it.

Bed Concrete: Manholes shall be built on a bed of 150mm thick cement concrete 1:2:4 mix (1 cement:2 coarse sand: 4 graded stone ballast 20 mm. nominal size).

Plaster: - Inside and outside of wall shall be plastered with 20 mm thick cement plaster 1:4 (1 cement: 4 coarse sand) finished with a floating coat of neat cement. In wet ground, outside plaster, shall be water proofed with addition of any other equal and approved water proofing compound. The water proof plastering shall be done 300mm. above wet ground.

Measurement: - Manholes shall be measured in civil works item breakdown format.

CI manhole covers shall be Swastika or equivalent heavy as per instruction. All manhole cover shall be of double seal and the frame of manhole shall be embedded firmly on RCC coupling. All surfaces of frames and cover shall be painted with coal tar. Manhole frames and covers shall be of clean well defined castings (i.e. key slots and edges shall be smooth and easy to access). Depth of manholes shall dictate size variations as per safety requirements. Manholes shall be integrated with the materials surrounding them in a manner which is astatically pleasing.

RCC precast manhole covers may be instructed. In which case they shall be 3" thick with 1 ½" x 1 ½" squares holes set in a neat pattern between the rebars and conforming to the drainage volume required to pass through the set of holes into the sink. The rebars shall be adequate to withstand rolling loads of motor trucks fully loaded. The size shall conform to the manhole or sink sizes.

Drop connections shall be provided between branch sewer and main sewer or in the main sewer itself in steep ground when the difference in invert level of the two exceeds 45 cms of the required sizes. Drop connections from gully traps to main sewers in rectangular manholes shall be made inside the manholes and shall have HCI special type door bend on top and heel rest bend at bottom connected by a HCI pipe. This pipe shall be supported by holder bat clamps at 180 cms intervals with at least one clamp for each drop connection. All joints shall be load caulked 25mm deep.

Drop connections from branch sewer to main sewer shall be made outside the manhole wall with cast iron LA pipe tee connections, vertical pipe and bend at the bottoms. The top of the tee shall be finished upto the surface level and provided with a CI hinged type frame and cover 30 x 30 cms. The connection shall be embedded in cement concrete 1:2:4 mix 15cms all round the pipe and tee upto the surface chamber of the tee.

Drop connection made from vertical stacks directly into man holes shall not be considered as drop connections. They shall be paid for under the relevant soil and waste pipes.

1715.7 Recharge Pit/ Soak Pit

The recharge pit/ Soak Pit work shall be done as per the Drawing. The earthwork in excavation shall be carried out to the exact dimensions given in the Drawing. The recharge pit shall be filled with brick bats from inside and outer wall shall be of 230mm brick masonry work as per the Drawing. Round the shaft and within the radius of given measurement shall be placed by 5-10mm aggregate up to 1m height. The top of the slab shall be as per the Drawing or direction of the Project Engineer.

1716 Excavation & Related Works for External Plumbing

1716.1 Alignment and grade

The drainage, water supply and sewer lines are to be laid to alignment and gradients shown on the drawings but subject to such modifications as shall be ordered by the engineer from time to time to meet the requirements of the works. No deviations from the lines, depths of cuttings or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the engineer.

1716.2 Opening out trenches

In excavation the trenches, etc. the soling, road metalling, pavement, kerbing etc. and turf is to be placed on one side and preserved for reinstatement when the trench or other excavation shall be filled up. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the engineer. The contractor shall not cut or break down any fence or trees in the line of the proposed works but shall tunnel under them, unless the engineer shall order to the contrary.

The contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the engineer.

1716.3 Obstruction of Roads

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and if insufficient space, he shall remove the materials excavated within a lead of the

200' and bring them back again when trench is required to be refilled. The contractor shall obtain the consent of the engineer in writing before closing any road to vehicular traffic and the foot-walks must be kept clear at all times.

1716.4 Removal of filth

All night soil, filth or any offensive matter met with during the execution of the works immediately after it is taken out any trench, sewer of composes, shall not be deposited upon the surface of any street or where it is likely to a nuisance of passed into any sewer or drain but shall at once be put into carts and remove to suitable place incontestable to the project & Employer.

1716.5 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer lines shall rest on concrete as described in the items relating thereto and so that the inverts may be the levels given on the sections. In bad ground, the Engineer may order the contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewer with concrete, broken stone, gravel, or other materials. For such extra excavation and concrete broken stone gravel or other materials the contractor shall be paid extra if the works were ordered by the engineer, in writing, but if the contractor should excavate the trench to a greater depth than is required without specific order to that effect in writing of the Engineer the extra depth shall have to be filled up with concrete at the contractors own costs and charges, to the requirements and satisfaction for the Engineer.

1716.6 Refilling

After the sewer or other work has been laid and proved watertight, the trench or other excavations shall be refilled. Almost care shall be taken in doing so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and up to 3" above the crown of the sewer shall consist of the finest selected materials placed carefully in 6" layers with materials taken from the excavation, each layer being watered to assist in the consolidation. Unless the Engineer shall otherwise direct. Turfing shall be laid over as instructed.

1716.7 Contractor to restore settlements and damage

The contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces,etc. whether public or private caused by his trenches or by his other excavations and he shall be liablefor any accidents caused thereby. He shall also, at his own expenses and charges, repair and make good any damage done to buildings and other property. If in the opinion of the Engineer the contractor fails to make good such works with all practicable dispatch, the Employer shall be entitled to carry out by his own workmen or other contractor and Employer shall be entitled to recover from the contractor as per conditions of contract.

1716.8 Disposal of Surplus Soil

The contractor shall at his own costs and charges provide, places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

1716.9 Timbering of sewer and trenches

The contractor shall at all times support efficiently and effectively the sides of the trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose or sandy strata below the surface of the sub-soil water level.

a. All timbering, sheeting and piling with their supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

b. The contractor shall be held responsible and accountable for the sufficiency of all timbering, bracing, sheeting and piling used for, all damage to persons and property resulting from improper quality, placing, maintaining or removing of the same.

1716.10 Shoring of buildings/structures

The contractor shall shore up all buildings and structures, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accidents to any of such buildings.

1716.11 Dewatering of Trenches

The contractor shall at all time during the progress of the work keep the trench and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use for the same by the public.

1716.12 Cement concrete, brickwork and finishing

Wherever applicable in this section the materials for cement concrete, brick masonry and finishing like plaster required for the manhole, chambers, gully trap, septic tank and other works shall conform to the specifications works and materials for civil works. The works, sizes etc shall be as shown in the drawings.

1716.13 Excess excavation

If any excavation is carried out at any point or points to greater width than the specified cross section of the sewer, or trench the full width the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of Engineer.

1716.14 Increased Width, Depth of Trench

The Engineer shall have power by giving an order in writing to the contractor to increase maximum width or depth in respect of which payment will be allowed for excavation in trenches of sewer, manholes, and other works in certain lengths to be specifically laid down by him, on account of bad ground or other unusual conditions, he considers that such increase width are necessary in views of site conditions.

Measurement

Unless stated in the item the measurement and payment of excavation shall be as per the terms of civil specifications.

1717 Maintenance Manual

The Contractor shall submit a draft outline of the proposed format and contents within 30 days after the issuance of the virtual completion certificate by the Engineer. The submitted manual will conform to the approved outline.

The Manual shall be contained in a black three ring loose-leaf binder and be subdivided into sections according to the various divisions of this specification. Material shall be fully indexed, with a typed contents page located at the front of the Manual. Tabbed sheets shall be used to subdivide the contents as required. All material shall be neatly and legibly presented. Photocopies will be used only if original documents are not available.

All materials shall be clearly labeled according to manufacturer, manufacturer's reference, source, location of use, and quantity.

Include in the Maintenance Manual a list of all materials submitted indicating quantities, source, manufacturer, manufacturer's reference(s), and location of use. Also include printed manufacturer or supplier's instructions on use, application, and maintenance of all products and materials.

1718 Cutting And Patching

Openings not indicated on the Engineering or Structural drawings, which are required for bringing equipment into the building or for other temporary or permanent service, shall be approved by the Engineer or Site In-charge. The contractor will provide maintain and restore these openings and shall pay for their provision and restoration. Ample notice shall be given of size and location of such openings. The contractor shall ensure that he does not undertake any cutting that may impair the strength of the building. No holes, except expansion bolts and small screws may be drilled into the structure without obtaining prior approval. Persons, skilled in the trades, shall do all cutting and patching work in a neat and workman like manner.

1719 Painting

All equipment supplied under this specification shall be delivered to the site with a factory applied prime coat of paint unless noted otherwise. All supports and hangers shall receive a prime coat of paint. Painting where required for pipe, duct services, equipment identification, including stenciling shall be carried out by a paint tradesman under this division in accordance with the workmanship and material specification. All factory prime-coated or finish coated equipment shall be touched up or repainted if equipment is marred during shipment or installation.

1720 Expansion and Contraction

Unless shown otherwise, the contractor shall be responsible for measures to control the thermal movement of piping and apparatus. Piping shall be erected in such manners that strain and weight does not come directly upon connections, joints or apparatus. Where possible, the effect shall be obtained by providing changes in direction and loops in pipe runs, supplemented by the necessary guides, anchors and limit stops.

1721 Pipe Sleeves

An adequate number of sleeves (pipe inserts) of mild steel shall be provided where pipes pass through concrete, masonry and similar work. The pipe inserts shall have a flange welded in the center around its circumference, in order to provide water tight and secure fixing into the structure. The sizes of the pipe sleeves (pipe inserts) shall be as per the drawings supplied and / or as given below.

1721.1 Sleeves through Exterior Walls below Grade

i. Sleeves in exterior foundation walls below grade shall project 25 mm beyond the outside surface of the wall and be flush with the inside surface.

ii. The annular space between the sleeve and the pipe shall be caulked with un-tarred oakum and sealed with approved caulking compound. The sealing shall be 25 mm deep from each side. The pipe and sleeve surfaces shall be cleaned to enable good bonding. Allow 24 hours for setting of the compound. The contractor shall adhere strictly to the manufacturer's recommendation.

1721.2 Sleeves through Interior Wall, Floor and Ceilings

i. Sleeves through interior masonry walls and partitions shall be set flush with finished wall surfaces.

ii. Sleeves through floors in finished areas shall terminate 25 mm above the finished floor.

iii. Sleeves through floors in service area (e.g., mechanical rooms) shall terminate 50 mm above the finished floor.

iv. The annular space between sleeves and pipes shall be packed with Silicon Rubber. In Machine Room, the packing shall be finished at both ends of the sleeve with 6 mm deep caulking compound. In other areas the finishing may be on the room side only.

v. Pipe insulation shall be carried full thickness through pipe sleeves.

Unless otherwise specified elsewhere, the sleeves size shall be as follows:

Table 5000.1: Sleeve Size

Out Side (OD) Diameter of Pipe (If Insulated, OD of Insulation)	Sleeve Size (Nominal Bore of the Pipe for Sleeve)
OD 20 mm to OD 32 mm	NB 2" (50 mm)
OD 33 mm to OD 75 mm	NB 4" (100 mm)
OD 76 mm to OD 125 mm	NB 6" (150 mm)

1722 Clean Up

The contractor shall clean all exposed metal surfaces from grease, dirt or other foreign materials. Chrome plated and polished work shall be left bright and clean. All openings in pipes and fixtures shall be properly capped and plugged during construction. Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned in accordance with the manufacturer's instructions.

1800 SPECIFICATION FOR ELECTRICAL, AND ALLIED WORKS

1801 General

The following specifications will apply under all circumstance to the equipment and fittings to be supplied and installed against this contract and it is to be ensured that the contractor shall obtain at his own expense and on his own responsibility for the purpose of making the bid and for entering into a contract keeping in view the specifications hereunder, design drawings of the electrical installation, bill of quantities (BOQ) and inspection of site etc.

1802 Standards

Where not specified within this Specification, all materials and workmanship used in the installation works shall be in accordance to the latest edition of the related IS Standards / NS, IEC, NEC, BS or equivalent.

Notwithstanding the stipulation of above standards, local electrical codes for electrical serves in buildings, where such exist, shall also be followed. Adequate consideration shall also be given to compliance of the equipment and works with local environmental conditions such as temperature, altitude, humidity, dust, vermin, attitude of personnel who will occupy the premises etc.

1803 Scope

For detail scope of the work, the contractor shall consult in detail the drawings, the conditions of contract, all related specifications, related standards, bill of quantity (BOQ) and inspection of the proposed site.

The scope of works generally includes the followings.

- The supply, delivery, fixing, installation, testing and commissioning of all required materials, fixtures, all electrical, Telecom, and Computer Networking equipment's and appliances as mentioned in BOQ.
- Conducting and electrical wiring for light fixtures, fans, power points, telephone points, switches, computer points, etc., (whichever applicable as per technical specifications, drawings, site conditions and bill of quantity)
- Testing and Commissioning of the entire electrical. Telecom, computer-networking installations.
- And other following related works:
- The works undertaken shall be fully coordinated with the civil works so that all electrical. Telecom, computer networking and allied works are set and finished in conformity with the building structural and architectural works. The work schedule shall also be coordinated so that no components of work schedules are interrupted owing to defective programming. Works to be undertaken are categorized under the following major sections:
- Lying of HDP/PVC conduits, PVC sleeves, outlet boxes, pull boxes and accessories required for the electrical wiring of the system.
- Wiring in concealed installed conduit to achieve desired electrical sub-circuits for the given electrical, telephone, computer layout.
- Installation of and termination of wiring to light fixtures, power outlets, ceiling fans, exhaust fans, switches, dimmers, regulators, telephone outlets, computer outlets, etc. (whichever applicable as per technical specifications, drawings, site conditions and bill of quantity).
- Installation of mains power cables form utility LV/HV take-off terminals of electricity authority (or the sub-station) to the main panel/distribution board.
- Installation of sub-mains power cables form utility main panel/distribution board to sub-distribution boards.
- Installation of main panel/distribution boards and sub distribution panels.
- Rectification and cabling of earth continuity conductor.

1804 Rates

The rate quoted in the tender shall include all charges of materials, installations, testing and commissioning, labor, tools and equipment's, shed for material store, transferring all materials from place of availability to the site, all applicable taxes and duties, contingencies, breakage, wastage and maintenance of installation for one year. The rate in the original contract shall determine the values of the extra works where such extra work is of a similar nature and has been executed under similar conditions.

Wherever the extra work is not of a similar nature, the rate for the same shall be determined prior to the execution of work and approved by the Engineer.

1805 Quantities

All quantities mentioned in the Priced Bill of Quantity are true within ± 1% and the contractor will get payment according to measurement of the actual work quantities. The schedule of quantities is liable to alteration by deletion or addition partially or wholly as required.

1806 Materials

The contractor must supply all the materials from authorized distributor/ supplier / manufacturer. Prior to installation of the electrical and allied goods, the contractor should provide all the samples with relevant catalogues, dealer / agent authorization certificates for conformation of the quality of the materials. The contractor shall test all materials to be supplied before and after the installation in presence of the consultant.

Good appearance and workmanship of the installation shall be of equal importance with its electrical and mechanical efficiency. All portions of the work shall be so laid and installed that the work as a whole would be uniform and shall present a neat and aesthetically pleasant appearance in a manner meeting the approval of the engineer. The Contractor shall verify in the field all measurements necessary for the electrical works and shall assume the responsibility for their accuracy.

Materials defective or damaged during the execution works shall be promptly replaced at the expense of the contractor. The Works shall be carried out in a manner so as to conform to the progress of the other trades and shall be completed as soon as the conditions of the building will permit.

1807 Drawings

2007.1 Design Drawings

The drawings provided are design drawings and generally are diagrammatic. They do not show offsets, bends, pull box, which may be required for the installation.

2007.2 Shop Drawings

Prior to commencing procurement, the contractor shall submit for approval, detailed shop drawings showing actual layout, dimensions, materials used, standards, cable / conduit / cable trunk route, single line diagrams showing the feeders / circuits to be connected, cable ratings, circuit breakers ratings, panel boards fabrication details of electrical, Computer, Telecom and Allied items. The detailed shop drawings shall be prepared by the electrical experts with minimum 2 years' experience in similar activities employed by the contractor. The contractor shall submit the CV of the electrical engineer to the consultant for approval.

2007.3 As Built Drawings

3 sets of fully computerized "As Built Drawings" (soft and hard copy) indicating actual route runs of conduits / cables, actual electrical layouts shall also be submitted at the completion of entire electrical, telecom, computer System installations.

All as built drawings shall be prepared by well experienced experts in relevant fields employed by the contractor.

1808 Samples

Prior to commencing procurement, the contractor shall submit for approval, technical description, related catalog/brochures and a sample item each of all electrical, telecom, computer items which are to be procured and installed.

1809 Contractors Experts / Supervisor

Contractor should have a full-time electrical engineer and a full-time electrical supervisor (well-experienced electrician), part/full time engineer, Computer Engineer etc, throughout the construction period for executing the work as per drawings, specifications and instructions of consultant. Also the contractor shall submit the bio-data of all relevant experts and supervisor with this offer.

1810 Cutting and Patching

Cutting and patching required for the proper installation and completion of works including plastering, masonry work, concrete work and patching should be done by the contractor himself using skilled labor.

1811 Storage and Protection

Particular care shall be taken to protect materials, equipment and fixtures against dampness and mechanical damage during period of storage and progress of construction and cleaning operations.

1812 Quality of Work

The work shall be carried out in the best workman like the contractor without any extra charge shall carry out defect or minor changes in the design etc. if pointed out.

Workmanship and good appearance of the installation shall be of equal importance with its electrical and mechanical efficiency, and all portions of the work shall be so laid out and installed that the work as a whole is of uniform quality and shall present a neat appearance in a manner meeting the approval of the Consultant. The contractor shall verify in the field all measurements necessary for the electrical work and shall assume responsibility for their accuracy.

1813 Progress and Completion of Works

The work shall be commenced immediately after the contractor receives instructions to proceed.

The contractor shall submit work schedule for execution of the project. The contractor shall employ adequate labors to complete the work within the schedule time and shall make his own arrangement for housing labor and materials etc.

Materials, which are defective or damaged during the progress of work, shall be replaced or repaired in an approved manner at the expense of the contractor. The progress of electrical and allied works shall be carried out so as to conform to the progress of the work of the other trade and the entire installation shall be completed as soon as the condition of the building will permit.

Upon completion of the installation of the lighting fixtures and lighting equipment they must be in first class operations order and in perfect conditions as to finish, etc. At the time of final inspection all fixtures and equipment must be complete with lamps and required glassware or reflector, which must be clean and free from defects. Any fixtures, reflectors or glassware broken prior to the time of final inspection and acceptance shall be replaced at the contractor's expense.

1814 Performance of Works

All cutting, drilling, channeling, patching, etc. required for installation of electrical and allied work shall be carried out in a manner approved by the Consultants. Any defecting of finish, plaster, woodwork, metalwork, masonry, concrete or other material, resulting from the performance of the work shall be replaced or repaired at no expense to the owner and to the approval of the Consultant.

1815 Inspection, Testing and Commissioning

The contractor shall notify in writing to the consultant about the completion of the work. Within the notified time, the consultant shall send his representative to remain present at the time of carrying out the tests by the contractor. The contractor shall fix up the date in consultation with the consultants for such test.

The contractor shall be responsible for providing all the necessary instruments for carrying out the tests without any extra charge.

Prior to test, feeders and branches shall be continuous from service contact point to each outlet; all panel feeders and devices connected and fuse in place. The contractor shall test the electrical and allied system for short circuits, earth fault, full load test, Insulation resistance test measured in mega ohm, earth resistance test and other related electrical tests. Test shall be carried out in accordance with the requirements of the Indian codes or equivalent and shall be conducted in the presence of the consultant. Any defect or damage during testing and commissioning shall be corrected or replaced by the contractor at his own cost.

1816 Maintenance and Guarantee

The contractor guarantees by his acceptance of the contract that all work installed will be free from any and all defects and that if during a period of one year from date of acceptance of work any such defects on workmanship material or performance replace, repair or otherwise correct the defects of deficiency, without any cost to the owner, within a reasonable time fixed by the consultant.

In the event of default on this guarantee by the contractor, the owner may have works done as required and recover the cost from the contractor.

1817 As-Installed Drawings

After all, tests on the completed installation have been approved, the contractor shall submit three copies along with the original set of as-installed Electrical, Telecom, Fire Alarm/Fight, HVAC and Computer Drawings in spiral-bound covers for subsequent maintenance and operation. These shall clearly indicate:
a. Conduit runs / route and sizes with the number and size of cables enclosed in the conduit accessories such as pull boxes, outlets etc.;

a) Distribution patterns and circuits in main and sub-main and distribution boards/boxes;

b) Location of earth stations and conductors;

c) Location of all electrical, telecom, and computer outlets appliances, equipment and components; underground and over ground cable routes, sizes, cable trays and ducts provided.

1818 Operation & Maintenance Instructions Manual

The contractor shall also provide three copies in a durable plastic case of operating and maintenance instruction manuals in English and with clear and readable text. The manuals shall comprise of the following in given order:

SECTION	INDEX
SECTION A	Description of the Installations (Electrical, Telecom, Computer Network System and Allied Works.
SECTION B	Test Reports
SECTION C	As Built Drawings (Electrical, Telecom, Computer Installations and allied installations)
SECTION D	Routine maintenance instructions including those of the manufacturer's and dates for ordering replacements.
SECTION E	Manufacturer's names, addresses etc. Including those of Local Agents.
SECTION F	All relevant original catalogues from Manufacturer.
SECTION G	List of recommended spare parts

One copy of Manual shall be made available at the time of commissioning of the works. Until the record drawings, prints, transparencies are approved by the Engineer, the contract shall not be considered as complete and final payment including the release of retention monies will be withheld until such drawings, etc., have been submitted to and approved the Engineer

1819 Sub-Contract

Prior to sub-let any part of the work, the contractor shall submit the detail company profile / CV of the company/ person for approval.

1820 Relevant Standards

Unless otherwise specified, electrical equipment's, materials and workmanship shall conform to the applicable current standards rules and IS/NBC/NEC/IEC/BS specifications. All products shall bear the mark of IS/NBC Standard. The following IS/British Standards specifications will apply to the equipment's to be used under this contract.

I.	Electrical Wirings Installations	-	IS 732-1989
II.	Electrical Safety	-	IS 5216(Part 1)1982
III.	Switch Fuse Units on cubical switches boards	-	IS 4047-1967
IV.	Distribution Boards	-	IS 2675-1966
V.	Enclosure for low voltage switchgear	-	IS 2147-1962
VI.	PVC Power Cables	-	IS 1554-1988
VII.	Flexible Cables	-	IS 4289 –1984
VIII.	Conduits for electrical installations	-	IS 9537-1980
IX.	Flexible conduits non metallic	-	IS 6946-1973
X.	Safety for luminaries	-	IS 1913-1978
XI.	Switch Socket and outlets	-	IS 4615-1968
XII.	Recessed Luminaries	-	IS 10322-1987
XIII.	Ceiling Fans and regulators	-	IS 374-1979
XIV.	Earthing	-	IS 3043-1966
XV.	MCB	-	IS 8828-1978

1821 Abbreviations Used

NEA	-	Nepal Electricity Authority
LT	-	Low Tension
HT	-	High Tension
AC	-	Alternating Current
MPB	-	Main Panel Board
MDB	-	Main Distribution Board
FDB	-	Floor Distribution Board
SDB	-	Sub Distribution Board
KV	-	Kilo Volt
KA	-	Kilo Ampere
PVC	-	Poly Vinyl Chloride
SWG	-	Standard Wire Gauge (British)
IS	-	Indian Standard
TP	-	Three Pole
DP	-	Double Pole
SP	-	Single Pole
TPN	-	Three Pole Neutral
MCB	-	Miniature Circuit Breaker
MCCB	-	Moulded Case Circuit Breaker
CT	-	Current Transformer

1822 Test

The contractor shall submit for rechecking, re-testing and approval, a technical description of the method applied to test the electrical integrity of the entire installation including the measurement of obtained earthing resistance and the insulation resistance of the installation. Tests shall be conducted on the completed installation to check the following:

- Polarity: to verify that all terminals are correctly connected with regard to line, neutral and earth.
- Insulation test between live and neutral conductors: to verify the Megger reading between line and neutral conductors is not below 1 Mega ohm with all switches and fuses on but fixtures and lamps out.
- Insulation test between all non-earthed conductors and the earth a live system is not below 1 Mega ohm from Megger reading.
- Earth resistance test including the earth-loop test; and
- Other tests to verify safety and integrity of the installation.

1822.1 Factory Tests

The following tests shall be performed at the manufacturer's works unless an alternative place is specified or approved to determine whether the materials and apparatus comply with the specification.
As many tests as in the opinion of the Engineer are possible shall be arranged together. Four copies of the records of all tests shall be furnished to the Engineer.

All instruments shall be approved by the Engineer and if required shall be calibrated by the National Physical Laboratory or other such body as may be approved as part of the Contract.

Tests shall be arranged to represent the working conditions as closely as possible.

Electrical tests shall be carried out at a frequency of 50 Hz unless otherwise approved by the Engineer and the rms voltage shall be measured or calculated in an approved manner.

Unless otherwise specified all tests shall be carried out in the manner prescribed in the relevant BS or where no BS applies, in a manner approved by the Engineer.

1822.2 Test at Site

1822.2.1 General

At least two months before the equipment is due to the delivered to site two copies of a site test schedule shall be submitted for approval which shall include details of methods of carrying out and recording the

performance acceptance tests and any other tests which are considered necessary to ensure that equipment is ready for service.

1822.2.2 Switch Gear

The following tests are to be carried out after the equipment has been completely erected and connected up on site. The tests shall be made in the presence and to the satisfaction of the Engineer. Before testing, testing procedure shall be prepared and submitted to Engineer for approval.

a) Panels
   1. Physical checks
   2. Duct or test on all bus bars
   3. Insulation resistance test

b) Earthing
   1. Physical checks
   2. Earth values and various earth points

c) Cables
   1. Physical checks
   2. Insulation resistance test

1822.2.3 Building Service

i. A visual inspection of the whole of the installation, covering equipment and section in subways, walkways, crossways and false ceilings where accessible.

ii. The operation of all accessories and items of equipment and a check for proper function, including such items as may have been supplied by others but wired under this contract. These tests shall be made under normal operating conditions and the results noted.

iii. For correct polarity of socket outlets, lighting switches and all other items where correctness of polarity is essential.

1823 Wiring

1823.1 General

Technical Specifications in this section cover the Internal Wiring Installations comprising of:

- Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
- Sub main wiring.
- Wiring for Fire Alarm System

1823.2 Standards and Codes

The following IS Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the IS Standard as amended up to date shall also apply. Wherever appropriate IS Standards are not available, relevant British and/or IEC Standards/NBC shall be applicable.

Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

660/1100 V grade PVC insulated wires.	IS 694: 1990
PVC conduits for electrical wiring.	IS 9537: Part III 1980
Switch socket outlets	IS 4615: 1990
Switches for domestic and similar purposes	IS 3854: 1997
Boxes for the enclosure of electrical accessories	IS 5133: Parts I &II 1969

Code of practice for personal hazard fire safety of buildings	IS 1644: 1998
Code of practice for electrical installation fire safety of buildings	IS 1646: 1997
Code of practice for electrical wiring installations	IS 732: 1989

1824 Conduits

1824.1 PVC Conduits

Wiring shall be carried out in recessed /surface PVC conduits. The PVC conduits conform to IS 9537 Part-III and shall be ISI embossed. The conduits shall be heavy gauge (minimum 2 mm wall thickness) and the interiors of the conduits shall be free from all obstructions. All joints in conduits shall be sealed/ cemented with approved solvent cement. Damaged conduits/ fittings shall not be used. Cut ends of conduits shall not have sharp edges.

1824.2 Bends

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

1824.3 Conduit Accessories

1824.3.1 Standard Accessories

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, PVC bends, PVC solid elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used Samples of all conduits fittings and accessories shall be got approved by Project Manager before use.

1824.3.2 Fabricated Accessories

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 3 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved cooler. A screwed brass stud shall be provided in all boxes as earthing terminal.

1824.3.3 Outlet Boxes for Light Fittings

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick Perspex / hylam sheet cover of matching color shall be provided.

1824.3.4 Outlet Boxes for Ceiling

Outlet boxes for ceiling fans shall be fabricated from minimum 3 mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100 mm depth and 60 mm sides. Each box shall be provided with a recessed fan hook in the form of one 'U' shaped 15 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex/ hylam sheet cover of matching color shall be provided.

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1824.4 Boxes for Modular Wiring Accessories

1824.4.1 Switch Boxes - Modular Type

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of inserting the conduits in the outlet boxes. Extra length of conduit shall be cut-off inside the box with the help of cutting blade. Molded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

1824.4.2 Modular Type Boxes for Socket/ Telephone/Call Bell Outlets

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of inserting the conduits in the outlet boxes. Extra length of conduit shall be cut-off inside the box with the help of cutting blade. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200 mm from floor or inside raceways on laboratory work tables, as indicated in drawings and/or as directed.

1824.5 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of PVC insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

Maximum no of PVC/MS insulated 660/1100 V grade aluminium/copper

Conductor cable conforming to IS: 694 – 1990

Nominal cross Sectional Area Sq mm	20 mm dia	25 mm dia	32 mm dia	40 mm dia
1.0	7	13	20	-
1.5	6	10	14	-
2.5	5	10	14	-
4.0	4	6	10	14
6.0	3	5	9	11
10.0	-	4	7	9

1825 Wires

Wiring shall be carried out with FRLS insulated 1100-volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall be brought

to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

1826 Laying of Conduits

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.
- Same rate shall apply for recessed and surface conducting in this contract.
- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conducting for loop ear thing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conducting.

1826.1 Recessed Conducting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embed the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embedded conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Consultant. For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

1826.2 Surface Conducting

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

1826.3 Fixing of conduit fittings and accessories

For concealed conducting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner. Loop ear thing wire shall be connected to a screwed earth stead inside outlet boxes to make an effective contact with the metal body.

1826.4 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socket joints shall be made fully water tight with white lead paste.

1826.5 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

1826.6 Protection against Dampness

All outlets in conduit system shall be properly drain and ventilated to minimize chances of condensation/sweating.

1826.7 Expansion Joints

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

1826.8 Loop Ear thing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid along with wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

1827 Laying and Drawing Of Wires

1827.1 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

1827.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.
- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary.
- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.
- There shall be no sharp bends.
- The Contractor shall, after wiring is completed, provide a blank metal/sun mica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen, the contractor shall replace the entire wiring along with loop earthing at no extra cost. No joint of any nature whatsoever shall be permitted in wiring and loop earthing.

1827.3 Termination /Jointing of Wires

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.
- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.
- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Project Manager in writing shall be obtained before making such joint.
- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.
- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection.
- Conductors having nominal cross sectional area exceeding 1.5 sq. mm shall always be provided with crimping sockets. Tinning of the strands shall be done wherever crimping sockets are not available as per instructions of the Project Manager

- All wiring shall be labelled with appropriate plastic ferrules for identification.
- At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.
- Brass nuts and bolts shall be used for all connections.
- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.
- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.
- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

1827.4 Load Balancing

The Contractor shall plan the load balancing of circuits in 3 phase insulation and get the same approved by the Project Manager before commencement of the work.

1827.5 Colour Code of Conductors

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

1828 Switches and Fixtures

1828.1 Switches

All 6, 13 and 16-amps switches shall be of the modular enclosed type flush mounted 220 Volt AC of the best quality and standard. The switch moving and fixed contacts shall be of silver nickel and silver graphite alloy and contact tips coated with silver. The housing of switches shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

The switch controlling the light point shall be connected on to the phase wire of the circuit.

1828.2 Flush Plates

Switches, receptacles and telephone system outlets in wall shall be provided with molded cover plates of shape, size and color approved by the Project Manager made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material, and secured to the box with counter sunk round head chromium plated brass screws. Where two or more switches are installed together, they shall be provided with one common switch cover plate as described above with notches to accommodate all switches either in one, two or three rows.

One and two gang switch cover plate, telephone outlet cover plate, 6 and 16 amps switched/ unswitched plates, shall have the same shape and size. Three and four gang switch cover plates shall have the same shape and size. Six and eight gang switch cover plates shall have the same shape and size. Nine and twelve switch cover plates shall have the same shape and size. Wherever five switches, seven switches, ten switches and eleven switches are to be fixed the next higher size of gang switch cover plate to be used and extra openings shall be provided with blank-off.

1828.3 Externally Operated Switches

Externally operated switches, shall be of general purpose type, 250 volts of the proper size and rating and shall be provided in weather proof enclosures, complete with weather proof gasket covers. The MCB's for all externally operated switches shall be separate and of proper rating.

1828.4 Wall Socket Outlets

All 6/16 amps wall socket outlets unless otherwise mentioned on the drawings shall be switched, five/six round pin and fitted with automatic linear safety shutters to ensure safety from prying fingers. Unswitched 6/13/16 amp wall socket outlets where called for in the drawings shall be of five/six round pin type. The socket outlets shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

The switch and sockets shall be located in the same plate. The plates for 6 amps switched/un switched plugs and telephone outlets shall be of the same size and shape.

All the switched and un switched outlets shall be of the best standard. The switch controlling the socket outlet shall be on the phase wire of the circuit.

An earth wire shall be provided along the cables feeding socket outlets for electrical appliances. The earth wire shall be connected to the earthing terminal screw inside the box. The earth terminal of the socket shall be connected to the earth terminal provided inside the box.

1828.5 Lighting Fixtures

The light fixtures and fittings shall be assembled and installed complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Consultant.

Wires brought out from junction boxes shall be encased in PVC flexible pipes for connecting to fixtures concealed in suspended ceiling. The flexible pipes shall be provided with a check nut at the fixture end.

Pendant fixtures specified with overall lengths are subject to change and shall be checked with conditions of the job and installed as directed.

All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and to the approval of the Consultant.

Fixtures shall be suspended true to alignment, plumb, level and capable of resisting all lateral and vertical forces and shall be fixed as required.

All suspended light fixtures etc. shall be provided with concealed suspension arrangement in the concrete slab/roof members. It is the duty of the Contractor to make these provisions at the appropriate stage of construction.

All switch and outlet boxes shall be bonded to earth with insulated stranded copper wire as specified. Wires shall be connected to all fixtures through connector blocks.

Flexible pipes, wherever used, shall be of make and quality approved by the Consultant.

a. Measurement and Payment of Wiring

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated.

Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

Wiring for light points, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch (for switch controlled lights). Rates for light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of light point thus defined including:

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required.
- Wiring with stranded copper conductor FRLS insulated 1100-volt grade wires including terminations etc. complete as required.
- Loop earthing with insulated copper wires.

b. Parameters: Wiring shall be carried out as per following parameters in recessed/ surface conduit system.

- Only looping system of wiring shall be adopted throughout. No joints excepting at wiring terminals shall be permitted.
- All accessories shall be flush type unless otherwise stated.
- For estimation of load, following loads per point shall be assumed.
- Light points 100 Watts.
- 6 amps socket outlet points 100 Watts.
- Fan points 60 Watts.
- Exhaust fan points 300 Watts or as specified.
- Amp socket outlet points 1000 Watts.
- Lights, fans and 6 amp socket outlets may be wired on a common final such circuit. Such circuit shall not normally have more than a total of ten lights, fans or socket outlets or a load of 800 watts whichever is lesser.
- Power circuits shall normally have maximum one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.

- Wiring rates shall include painting of conduits and other accessories as required.
- Wiring rates shall include cleaning of dust; splashes of color wash or paint from all fixtures, fans, and fittings etc. at the time of taking over of the installation.
- Wiring rates shall include blanking of outlet boxes to prevent damage/pilferage of wires

1829 Routine and Completion Tests

1829.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

1829.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

1829.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one mega ohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a mega ohm or when PVC insulated cables are used for wiring 12.5 mega ohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Mega ohms is acceptable.

1829.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

1829.5 Testing Of Polarity of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labelled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Consultant Manager as well as the local authorities.

1829.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

1829.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

1829.8 Tests and Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Consultant for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

1830 Medium Voltage Distribution Boards

1830.1 General

This section covers specification of DBs.

1830.2 Standards and Codes

The following IS Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC circuits IS 8828: 1978

Degrees of Protection provided by enclosures for low voltage switchgear IS 2147: 1962

Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts IS 10118: 1982

General requirements for switchgear and control gear for voltages not exceeding 1000 volts IS 4237: 1982

1830.3 Miniature Circuit Breakers

- The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with PVC cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

1830.4 Final Distribution Boards

- Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.
- The distribution equipment forming a part of the Distribution Boards shall comply with the relevant Standards and Codes of the Bureau of Indian Standards and as per detailed specifications included in this tender document.
- The board shall be fabricated from 16 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cut-outs and covers shall be provided with synthetic rubber gaskets. The entire construction shall give an IP 42 degree of protection.
- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length. The minimum spacing between phases shall be 25 mm and between phase and earth 19 mm
- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.
- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.
- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.
- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Project Manager.
- A sample of the completed board is to be got approved by the Project Manager before commencement of supply and erection.
- Before commissioning, the distribution boards shall be meager tested for insulation and earth continuity.

1830.5 Sheet Steel Treatments and Painting

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, de-scaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

1830.6 Name Plates and Labels

- Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

1831 Earthing

1831.1 General

This section covers the general arrangement of the earthing, i.e. all non-current carrying metal parts of the electrical installation shall be earthed as per IS 3043(1987) and general specifications for electrical works (part-1, internal) of CPWD specifications. All metal conduits, trunkings, cable sheaths, switchgear, distribution boards, meters, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be in conformity with the provisions of Rule 32, 61, 62, 67 and 88 of IER 1956. The earth electrode shall not be situated less than 1.5 mtr.

1831.2 Earthing Systems

It shall comprise of earth electrodes, earth strips, earth continuity conductor and all earthing conductors shall be of high conductivity copper, GI or aluminium and shall be protected against mechanical damage and corrosion. The size of earth conductors shall not be less than half that of the largest current carrying conductor. The connection of earth continuity conductors of earth bus and earth electrodes shall be strong and sound and shall be rigidly fixed to the walls, cable trenches, cable trays or conduits and cable by using suitable clamps made of non ferrous metals.

1831.3 Earthing Electrodes

Earthing electrodes shall be designed as per the requirement of IS 3043 (1987). The number and size of earth electrodes shall be calculated so that under fault conditions no electrode is loaded above its maximum permissible current density. The resistance of earth electrode shall be as low as possible, the maximum allowable value being one ohm.

Earthing electrodes of either plate type or pipe type may be adopted. The choice of plate or pipe electrode shall be decided according to the anticipated fault level of the network and local soil conditions. Generally, plate electrodes shall be used for substations and large medium voltage network and pipe electrodes for small medium voltage network and installations.

1831.3.1 Location of Earth Electrodes

Normally on earth electrode shall not be situated less than 1.5 m from any building. Care shall be taken that the excavation for earth electrode may not affect the column footings or foundation of the buildings. In such cases electrodes may be further away from the building.

The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating earth electrode.

1831.3.2 Water Arrangement

Method of watering arrangement shall comply with CPWD General Specifications.

1831.3.3 Plate Electrode

Plate electrodes shall be made of GI plate of 6 mm thick and 60x60 cm. size. The plate shall be buried vertically in ground at depth of not less than 3.5 metres to the top of the plate, the plate being encased in charcoal to a thickness of 15 cm. all round. It is preferable to bury the electrode to a depth where sub-soil water is present. Earth leads to the electrode shall be laid in a GI pipe and connected to the plate electrode with GI bolts, nuts and washers. A GI pipe of not less than 19 mm dia shall be placed vertically over the plate and terminated in a funnel at 5 cm. above ground. The funnel shall be provided with a wire mesh. The funnel shall be enclosed in masonry chamber of 100 x 50 cm. dimensions. The chamber shall be provided with CI frame cover of 100 x 50 cm size. The earth station shall also be provided with a suitable permanent identification label/tag.

Note: If copper plate is used it shall be of 3mm thickness.

1831.3.4 Pipe electrode

Pipe Electrode shall comprise of a 2.5 Mtr. long 40 mm dia GI pipe buried vertically in a pit of 35 x 35 cm size and filled with alternate layers of charcoal, salt and river sand and connected at the top to a GI pipe of 19 mm, 1 Mtr. long with a funnel at the other end, 5 cm above the ground. The earth lead shall be properly fixed to the pipe electrode with brass bolts, nuts and washers. The funnel and earth lead connections shall be enclosed in a masonry chamber of 30 x 30 x 30 cm. dimensions. The chamber shall be provided with a CI frame and CI cover. Proper permanent identification tag/label shall be provided for each electrode.

1831.4 Installation

1831.4.1 Earthing Accessories

All joints shall be reverted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers, etc shall be cadmium plated. Main earth bars shall be spaced sufficiently away from the surface to which they are fixed, such as walls or the side of trenches to allow for easy connections. Copper earth bars shall not be fixed by ferrous fittings. The earthing shall be suitably protected from mechanical injury by galvanized iron within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to the plate or pipe as the case may be. In the case of the plate, the lead shall be connected by means of cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

1831.4.2 Method of Installation of watering arrangement

In the case of plate earth electrode a watering pipe of 20 mm dia of medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top for watering the pit. In case of pipe earth electrode a 40 mm x 20 mm reducer shall be used for accessing the funnel. The watering funnel attachment shall be housed in masonry enclosure of not less than 30 cm x 30 cm x 30 cm. A cast iron cover having locking arrangement shall be suitably embedded in the masonry enclosure.

1831.5 Precautions

- Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after passages of fault currents.
- Joints shall be soldered, tinned and double riveted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be provided against corrosion.
- The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a 15 mm dia GI pipe in case of wire and by 40 mm dia medium class GI pipe in case of strips. Portion of this protection pipe within the ground shall be buried at least 30 cm deep (to be increased to 60 cm

in case of road crossing and pavements). The portion within the building shall be recessed in walls and floor to adequate depth.

1831.6 Testing

- On the completion of the entire installation, the following tests shall be conducted and no earth electrode shall have ohmic resistance of more than 2 ohm and in rocky soil not more than 3 ohms.
  a) Earth resistance of electrodes
  b) Impedance of earth continuity conductors as per E-3 of IEE regulations.
  c) Effectiveness of earthing as per E-4 & E-5 of IEE regulations.
- All meters, instruments and labour required for the tests shall be provided by the contractor. The test results shall be submitted in triplicate to the Architects for approval.

1832 Lightning Protection System

1832.1 General

The Lightning Protective System shall comprise of Air Terminations, Down Conductors, Earth Terminations etc as required. The System shall preferably use the same conducting material throughout and will comply to the detailed specifications detailed hereinafter.

The entire lightning system should be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke.

1832.2 Materials

The materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the Schedule of Quantities and shall comply to the following requirements:

a) Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian Standard Specifications.

b) Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1968.

c) The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

1832.3 Air Terminations

1832.3.1 Vertical Air Terminations

Vertical air terminations shall comprise of finials made of 25 mm dia GI tube with single or multiple prongs at the top. Vertical terminations where provided shall project 30 cms above the project salient point or network on which it is fixed.

1832.3.2 Horizontal Air Terminations

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 m away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is to be used. For a roof of larger area network of parallel horizontal conductors shall be installed. Horizontal air terminations should be coursed along contours such as ridges, parapets and edges of the flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves form a closed network.

All metallic finials, chimneys, duct, vent pipes, railings, gutters, and the like on or above the main surface of the roof of the structure should be bonded to and form part of the air termination network.

1832.4 Down Conductors

The Down Conductors shall be of material as specified in the Schedule of Quantities. These shall be distributed around the outside walls of the structure and shall preferable be run along the corners and other projections. Lift shafts shall not be used for fixing the Down Conductors.

The routing of the Down Conductors shall be such that it is accessible for inspection, testing and maintenance.

1832.5 Testing Joints and Bends

The lightning protective system should have as few joints in it as possible.

Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective.

In the down conductor below ground level there shall be no joints.

The joints may be clamped, screwed, bolted, riveted, sweated braced or welded. Bolted joints should be used on test points or on bonds to existing metal.

Each down conductor should be provided with a testing joint in a position convenient for testing but inaccessible for interference.

1832.6 Fasteners

Conductors shall be securely attached to the building by fasteners which shall be substantial in construction, not subject to breakage.

These shall be of galvanized steel or other suitable materials with suitable precautions to avoid corrosion.

The method and nature of the fixing should be simple, solid and permanent. The lightning conductors shall be secured at not more than 1.20 m apart for horizontal run and 1.00 m for vertical run.

1832.7 Earth Termination

Each down conductor shall have an independent earth termination and all earth terminations should be interconnected.

1832.8 Earth Electrodes

Earth electrodes shall be constructed and installed as laid down in the IS 3043.

1832.8.1 Plate Earth Electrode

The plate electrodes shall be of Copper or G.I. as called for in the Bill of Quantities. The minimum dimensions of the electrode shall be G.I. 600 mm x 600 mm x 6 m thick and for Copper 600 mm x 600 mm x 3 mm.

The electrode shall be buried in ground with its face vertical and top not less than 3 m below ground level.

1832.8.2 8.2 Earth Electrode Pit

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/M.S. frame with cover having locking arrangement shall be suitably embedded in the masonry enclosure.

1832.8.3 Location of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

- An earth electrode shall not be situated less than 2 meters from any building.
- The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.
- The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.
- Entrances, pavements and road ways shall not be used for locating the earth electrode.

1832.9 Earth Resistance

The whole of the lightning protective system should have a combined resistance to earth not exceeding 10 ohms before any bonding has been effected to metal or on a surface or to surface below ground.

1833 Medium Voltage Panels

1833.1 General

Medium voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing wall mounting type, totally enclosed, compartmentalized design having multi tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall

conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

1833.2 Construction

All switch board panels or power control centers of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Architects/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or switch fuse feeders of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side if required. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with IS: 5578 -1985 and 11353-1985.

The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc.

1833.3 Dimensions

All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2200 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 mtr. for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections, consideration will be given to the place of sectionalisation and select the location where the minimum electrical connections are transferred from one section to another. All the hardwires used in the assembly will be electroplated for protection and neat appearance.

1833.4 Bus Bars

The bus bars shall be suitable for 4 wire, 415 volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminium and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fibre, reinforced polyester or moulding compound. The interval between the two insulators will be designed after considering:

- Strength and safe load rating of the insulator,
- The vibrating force generated during a fault,
- A Factor of safety of 1.8
- A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45o above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm shall not be exceeded for aluminium bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

1833.5 Earthing

The panels shall be provided with an aluminium or copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthling eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

1833.6 Interlocking

The panels shall be provided with the following interlocking arrangement.

- The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in 'OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.
- It shall not be possible for the breaker to be withdrawn when in 'ON' position.
- It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.
- The breaker shall be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of these position.
- A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

1833.7 Protection & Instrumentation

Protection and instrumentation shall be as per standard specifications.

1833.8 Control Wiring

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly, all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 10 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

1833.9 Surface Treatment

Each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphates before red oxide primer is applied. The panel shall be stove enameled Gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

1833.10 Enclosure

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per IS: 13947. The entire nut bolts handles, meters; knobs etc. appearing from outside of the panel should be located in symmetry so as to give a neat appearance.

1833.11 Name Plate

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

1833.12 Testing

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS: 3659.

1833.12.1 Insulation Test

- Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.
- Insulation resistance to earth of all secondary wiring should be tested with 1000 volt meggar.

Insulation test shall be carried out both before and after high voltage test.

1833.12.2 High Voltage Test

A high voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

1833.13 Storing, Erection and Commissioning

The panels shall be stored in a well ventilated, dry place, with a suitable polythene covers shall be provided for necessary protection against moisture.

1833.13.1 Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

1833.13.2 Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Architect's/Consultant's or their representatives.

- All main and auxiliary bus bar connections shall be checked and tightened.
- All wiring termination and bus bar joints shall be checked and tightened.
- Wiring shall be checked to ensure that it is according to the drawing.
- All wiring shall be tested for insulation resistance by a 1000 volts megar.
- Phase rotation tests shall be conducted
- Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.
- All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

1834 Metering, Instrumentation and Protection

The specifications hereinafter laid down shall cover all the meters, instrumentation and protective devises required for the electrical work. The ratings, type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities and drawings.

1834.1 General

Direct reading electrical instruments shall be in conformity with IEC-51, BS: 89 or IS: 1248. The accuracy of direct reading shall be 1.0 for voltmeters and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meters shall be suitable for continuous operation between 10°C ± circular patterns. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instrument meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be

possible without removal of the seal. The meters shall be provided with white dials and black scale marking. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right. Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

1834.1.1 Ammeters

Ammeters shall be moving iron type. The moving part assembly shall be with jewel bearings. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. The ammeters shall be manufactured and calibrated as per the latest edition of IS 1248 or BS 89. Ammeters shall be instrument transformer operated, and shall be suitable for 5 A. Secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

1834.1.2 Voltmeters

Voltmeter shall be of moving iron type. The range for 400 volts, 3 phase voltmeters shall be to 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

1834.2 Instrument Transformers

1834.2.1 Current Transformers

Current transformers shall be in conformity with IS: 2705 (Part-I, II, & III) in all respects. All current transformers to be used in the L.T. Electrical panels shall be low tension, ring type resin cast current transformer with the requisite currents ratio having secondary of the current transformers selected will be based on the following;

- For energy measuring: 1.0 class of accuracy.
- For other metering: 1.5 class of accuracy.
- For protects on: 3.0 class of accuracy. Where a common CT is used for different functions the CT accuracy class will be equal to the best class required by any of those function.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Current transformers shall be provided with earthing terminals for earthing chassis frame work and fixed part of the metal casing (if any). Each CT shall be provided with rating plate indicating the following:

- Name and make
- Serial Number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

The current transformers to be selected for this panel will have at least 20% extra VA capacity available over the normal capacity based on the following details;

- For ammeters : 3 VA
- For current coils of KW & KWHR, PF, KVAR meters or for all recorders: 5 VA.
- For normal wiring: 2 VA.
- For current coil of protection relays: 10 VA under no circumstances the VA rating of the CT's will be less than 15 VA.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CTs shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

1834.3 Watt Meters, Frequency Meters, Power Factor Meters

i) Watt Meters: Watt meters shall be of three phase, electro-dynamic type, suitable for use with current and potential transformers associated with the particular panel. Watt meters shall be provided with a maximum demand indicator.

ii) Power factor meters: Polyphase power factor meters shall be of electro-dynamic type with current and potential coils suitable for operation with current transformers and potential transformers associated with the particular panel. The scale shall be calibrated for 50% lag - 100% - 50% lead readings. Phase angle accuracy shall be + 4 degree.

iii) Energy meters and reactive power meters: Trivector meters shall be two element, integrating type kilowatt-hour, KVA, Kilovolt - ampere - hour reactive meters. The meters shall conform to IEC - 170 in all respects. Energy meters, KVA and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy consumption of 500 Hours corresponding to maximum current at the rated voltage and unity power factor. These meters shall be suitable for operation with current and potential transformers associated with the particular panel.

1834.4 Control Devices

1834.4.1 Push Buttons

The push buttons used in the panels will be rated for more than 415 volts and 2 amps. All the push buttons will be mounted on the front door and the assembly will be in two parts. All the push buttons will be mounted on the front door of the cubicle in regular symmetrical fashion as per the general norms being practiced. Only one make of push buttons will be used in the assembly of all the panels. The selection of the colour of the push buttons will be as follows

Function	Colour
Starting/Switching ON	Green
Stopping/Switching OFF	Red
Resetting	Black
Forward ON	Yellow
Reverse ON	Blue
Emergency OFF	Red/Mushroom

1834.4.2 Indicating Lights

The indicating lights used in the panel will be pleasant looking and round shape having the following features;

- A separate front lens for it's easy replacement.
- Facility to replace the bulb from the front.
- Bay net pin cap bulbs of standard size to be used.
- The shape of the lens to allow viewing from sides.
- Series resistance with use of low voltage bulb for longer life.
- Clear and distinct indication for light ON and OFF with differences of brightness of the lens.

The selection of the colours of the indicating lamps will be as follows:

- Red for system in operation
- Amber for system ready for operation.
- Green for system being put off.
- Red, yellow and blue for incoming supply.

1834.5 Testing

1834.5.1 Instrument transformers shall be tested at factory as per IS: 2705 & IS: 3156. The test shall incorporate the following:

a) Type tests

b) Routine tests

Original test certificates in triplicate shall be provided.

1834.5.2 Meters shall be tested as per IS: 1248. The tests shall include both type tests and routine tests. Original test certificate in triplicate shall be furnished.

a) Suitable injection tests shall be applied to the secondary circuit of every instrument to establish the correctness of calibration and working order.

b) All relays and protective devices shall be tested to establish correctness of setting and operation by introducing a current generator and an ammeter in the circuit.

1835 Moulded Case Circuit Breakers/ACB

1835.1 General

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to IEC: 947-II or IS: 13947-II in all respects. MCCB shall be suitable for three phase 415 volts AC. Suitable discrimination shall be provided between upstream and downstream breakers in the range of 10-20 milli seconds. All MCCBs will have earth fault module (if specifically asked) and front operated. All four pole MCCB shall be suitable for three phase four wire system, with the neutral clearly identified and capable of first make last break feature.

1835.2 Construction

The MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material, operating handle shall be quick make/quick break. The operating handle shall have suitable 'ON' 'OFF' and 'TRIPPED' mechanical indicators notable from outside. All MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases. The MCCB should be suitable for disconnection and isolation with marking on front name plate.

Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic tripping device shall have IDMT characteristics for sustained over load and short circuits. All MCCBs above 250 Amps will also have short circuit magnetic pickup level adjustment.

1835.3 MCCBs/ACBs

All MCCBs/ACBs shall have variable electronic releases from 50% to 100% which can be adjusted at site.

3.0 Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances. All MCCBs of higher ratings above 250 Amps shall be provided with separate extended arcing contacts.

1835.4 Interlocking

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent the door being opened when the breaker is in ON or OFF position.
- Defeat-interlocking device to open the door even if the breaker is in ON position.

1835.5 Breaking Capacity

The moulded case circuit breaker shall have a rated service. Short circuit breaking capacity of not less than 25 KA rms at 415 volts AC. Wherever required, higher breaking capacity breakers to meet the system short circuit fault shall be used.

1835.6 Accessories

All the accessories like shunt, under-voltage contact blocks shall be of snap fitting possible at site.

1835.7 Testing

- Original test certificate of the MCCB shall be furnished.
- Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

1836 External Lighting

The specifications cover the supply, installation, testing and commissioning of the following items:

- Street/Boundary lighting poles complete with all accessories e.g. looping box, clamps and required hardware's etc.
- Street/boundary lighting fixtures complete with all accessories e.g. lamps latest etc.
- Wiring of street light fixtures.
- Cable laying, earthing and inter connection
- Foundation of poles and erection.

- All the items should be tested and installed as per the latest Indian standards specifications and all the sundry items such as clamps, bolts, nuts, racks, support miscellaneous wiring etc., required to make the installation complete shall be taken care while quoting the major items.

1836.1 Steel Tubular Pole

The poles for street lighting purpose shall be complete in all respects and shall confirm to IS: 2713 unless otherwise specified. All poles shall be complete with base plate of 400 mm x 400 mm x 10 mm thick welded to bottom. The poles shall be provided terminal box for looping in and looping out of cables and shall consists fuse / MCB as specified. The looping box shall be suitable for outdoor installation and complete with all hardwares such as clamp, bolts, earthing studs, lockable door etc. and shall be paint also in the same manner as specified for poles. The poles shall be provided with two numbers of GI pipes of suitable dia for cable entry as shown in drawing. The poles shall be painted with two coats of red oxide primer on both outside and the portion of the pole below the ground before erection and two coats of aluminium paint of approved shade after erection over the exposed portion.

1836.2 Erection of Pole

While loading, transporting, unloading and erecting the poles care shall be taken so that the poles do not get bent. Out of shape and where necessary such defects shall be rectified before the poles are erected in position. The poles shall be erected in plumb line and correct level as indicated in the drawing and to the satisfaction of the Engineer-in-charge. They shall be kept in this position with the help of manila ropes until the foundation are constructed (for a minimum period of 10 days) and the back filling is complete. Foundation shall be made with reinforced cement concrete (1:2:4) and not less than 200 mm thick all round. The pole base plate shall be fixed over 150 mm thick concrete bed. Foundation shall be continued upto 300 mm or more above ground level as per location of the pole to avoid ingress of water logging etc. The foundation shall be tapered suitably into a collar. The excavated portion shall be filled back with earth and consolidated. The cement concrete foundations shall be cured properly by covering the same with water soaked or moist gunny bags at least two weeks before loading the pole.

1836.3 Erection of Light Fixtures

Each light fixture shall be connected to the supply through fuse/MCB of a suitable rating mounted in the looping box. The fitting shall be fixed to the pole properly and securely.

1836.4 Wiring of Light Fixtures

The wiring of lighting fixtures from terminal block by means of 2.5 Sq.mm PVC insulated single core copper conductor through a suitable rated MCB/fuse and neutral. Cost of single core connecting cable from junction box to lighting fixture and earth wire complete with connections are included in the quoted rate.

1836.5 Cabling Works

All cable installation work shall be done as per relevant clauses of section cable work.

1836.6 Tests

Before handing over the installation, tests on all fittings and cables shall be carried out as per IS specification.

The tests shall include;

a) Meggar test

b) Continuity test

c) Polarity test and phase sequence test

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