Employment Intensive Infrastructure Programme in Lebanon (EIIP)

BID DOCUMENT

ITB 63/2019

Annex E-2

Technical Specifications-Volume 2

Construction of a Vegetable Market

Al Qaa, Bekaa

Lebanon, August 2019
# TECHNICAL SPECIFICATIONS-VOLUME 2

- **STRUCTURAL**,  
- **ARCHITECTURAL**,  
- **MECHANICAL, ELECTRICAL AND PLUMBING (MEP) WORKS**,  
- **LANDSCAPING WORKS**

## INDEX

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIV 1</td>
<td>GENERAL REQUIREMENTS</td>
<td>1/1</td>
</tr>
<tr>
<td>DIV 2</td>
<td>SITE WORK</td>
<td>2/1</td>
</tr>
<tr>
<td>DIV 3</td>
<td>CONCRETE WORK</td>
<td>3/1</td>
</tr>
<tr>
<td>DIV 4</td>
<td>MASONRY</td>
<td>4/1</td>
</tr>
<tr>
<td>DIV 5</td>
<td>METALS</td>
<td>5/1</td>
</tr>
<tr>
<td>DIV 6</td>
<td>WOOD AND PLASTICS</td>
<td>6/1</td>
</tr>
<tr>
<td>DIV 7</td>
<td>THERMAL AND MOISTURE PROTECTION</td>
<td>7/1</td>
</tr>
<tr>
<td>DIV 8</td>
<td>DOORS AND WINDOWS</td>
<td>8/1</td>
</tr>
<tr>
<td>DIV 9</td>
<td>FINISHES</td>
<td>9/1</td>
</tr>
<tr>
<td>DIV 10</td>
<td>SPECIALTIES</td>
<td>10/1</td>
</tr>
<tr>
<td>DIV 15</td>
<td>MECHANICAL WORKS</td>
<td>15/1</td>
</tr>
<tr>
<td>DIV 16</td>
<td>ELECTRICAL WORKS</td>
<td>16/1</td>
</tr>
<tr>
<td>DIV 17</td>
<td>LANDSCAPING WORKS</td>
<td>17/1</td>
</tr>
</tbody>
</table>
## DIVISION 1

### GENERAL REQUIREMENTS

### INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>01101</td>
<td>INTRODUCTORY ITEMS</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CONTRACT CONSIDERATIONS</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>HEALTH SAFETY AND ENVIRONMENT</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PROJECT IDENTIFICATION, INFORMATION AND SAFETY SIGNS</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>SITE ACCOMODATION AND EQUIPMENT</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>TEMPORARY CONSTRUCTION CONTROLS AND FACILITIES</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>TRAFFIC REGULATIONS</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>SUBMITTALS</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>MATERIALS AND EQUIPMENT</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>FIELD ENGINEERING AND SURVEYING</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>MEETINGS</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>CONSTRUCTION PROGRESS SCHEDULES</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>CONSTRUCTION PHOTOGRAPHS</td>
<td>46</td>
</tr>
</tbody>
</table>
### DIVISION 2

**SITE WORK**

<table>
<thead>
<tr>
<th>INDEX</th>
<th>DESCRIPTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>02200</td>
<td>EXCAVATION &amp; EARTHWORK</td>
<td>1</td>
</tr>
<tr>
<td>02515</td>
<td>HARD LANDSCAPING</td>
<td>11</td>
</tr>
<tr>
<td>02900</td>
<td>SOFT LANDSCAPING</td>
<td>17</td>
</tr>
</tbody>
</table>
## DIVISION 3

**CONCRETE WORK**

### INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Commencing On Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>03010</td>
<td>CONCRETE MATERIALS</td>
<td>1</td>
</tr>
<tr>
<td>03100</td>
<td>CONCRETE FORMWORK</td>
<td>4</td>
</tr>
<tr>
<td>03200</td>
<td>CONCRETE REINFORCEMENT</td>
<td>9</td>
</tr>
<tr>
<td>03300</td>
<td>CAST-IN-PLACE CONCRETE</td>
<td>14</td>
</tr>
<tr>
<td>03310</td>
<td>CONCRETE TOLERANCES</td>
<td>38</td>
</tr>
<tr>
<td>03500</td>
<td>BEDS AND SCREEDS</td>
<td>46</td>
</tr>
<tr>
<td>03520</td>
<td>LIGHTWEIGHT CONCRETE</td>
<td>52</td>
</tr>
</tbody>
</table>
## DIVISION 4

### MASONRY

#### INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>04100</td>
<td>MASONRY MORTAR</td>
<td>1</td>
</tr>
<tr>
<td>04220</td>
<td>CONCRETE UNIT MASONRY</td>
<td>5</td>
</tr>
<tr>
<td>04270</td>
<td>GLASS MASONRY UNITS</td>
<td>15</td>
</tr>
<tr>
<td>04400</td>
<td>STONE</td>
<td>18</td>
</tr>
</tbody>
</table>
## DIVISION 5

### METALS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>05010</td>
<td>METAL FIRST FIXING MATERIALS</td>
<td>1</td>
</tr>
<tr>
<td>05030</td>
<td>METAL FINISHES</td>
<td>6</td>
</tr>
<tr>
<td>05500</td>
<td>METAL FABRICATIONS</td>
<td>12</td>
</tr>
</tbody>
</table>
## DIVISION 6

**WOOD AND PLASTICS**

### INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>06100</td>
<td>ROUGH CARPENTRY</td>
<td>1</td>
</tr>
<tr>
<td>06300</td>
<td>WOOD TREATMENT</td>
<td>3</td>
</tr>
<tr>
<td>06400</td>
<td>ARCHITECTURAL WOODWORK</td>
<td>7</td>
</tr>
</tbody>
</table>

## DIVISION 7
### THERMAL AND MOISTURE PROTECTION

**INDEX**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>07100</td>
<td>WATERPROOFING</td>
<td>1</td>
</tr>
<tr>
<td>07180</td>
<td>CEMENTITIOUS WATERPROOFING</td>
<td>12</td>
</tr>
<tr>
<td>07200</td>
<td>THERMAL INSULATION</td>
<td>15</td>
</tr>
<tr>
<td>07300</td>
<td>ROOFING TILES</td>
<td>18</td>
</tr>
<tr>
<td>07462</td>
<td>STAINLESS STEEL CLADDING</td>
<td>22</td>
</tr>
<tr>
<td>072600</td>
<td>FLASHING AND SHEET METAL</td>
<td>32</td>
</tr>
<tr>
<td>07800</td>
<td>CANOPY</td>
<td>35</td>
</tr>
<tr>
<td>07900</td>
<td>JOINT SEALERS</td>
<td>38</td>
</tr>
</tbody>
</table>

### DIVISION 8

**DOORS AND WINDOWS**
## INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>08110</td>
<td>STEEL DOORS</td>
<td>1</td>
</tr>
<tr>
<td>08120</td>
<td>ALUMINIUM DOORS AND WINDOWS</td>
<td>11</td>
</tr>
<tr>
<td>08210</td>
<td>WOOD DOORS</td>
<td>24</td>
</tr>
<tr>
<td>08300</td>
<td>OVERHEAD DOORS</td>
<td>30</td>
</tr>
<tr>
<td>08700</td>
<td>IRONMONGERY</td>
<td>36</td>
</tr>
<tr>
<td>08800</td>
<td>GLAZING</td>
<td>52</td>
</tr>
<tr>
<td>08930</td>
<td>GLAZED ALUMINIUM CURTAIN WALLS</td>
<td>58</td>
</tr>
</tbody>
</table>
**DIVISION 9**

**FINISHES**

**INDEX**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>09120</td>
<td>CEILING SUSPENSION SYSTEMS</td>
<td>1</td>
</tr>
<tr>
<td>09220</td>
<td>PORTLAND CEMENT PLASTER</td>
<td>5</td>
</tr>
<tr>
<td>09225</td>
<td>EXTERNAL RENDER</td>
<td>9</td>
</tr>
<tr>
<td>09310</td>
<td>CERAMIC WALL TILES</td>
<td>13</td>
</tr>
<tr>
<td>09312</td>
<td>CERAMIC FLOOR TILES</td>
<td>19</td>
</tr>
<tr>
<td>09420</td>
<td>TERRAZZO</td>
<td>24</td>
</tr>
<tr>
<td>09515</td>
<td>SUSPENDED CEILING SYSTEMS</td>
<td>30</td>
</tr>
<tr>
<td>09570</td>
<td>WOOD FLOORING</td>
<td>35</td>
</tr>
<tr>
<td>09615</td>
<td>MARBLE</td>
<td>44</td>
</tr>
<tr>
<td>09620</td>
<td>GRANITE</td>
<td>49</td>
</tr>
<tr>
<td>09800</td>
<td>SPECIAL COATINGS</td>
<td>55</td>
</tr>
<tr>
<td>09900</td>
<td>PAINTING</td>
<td>59</td>
</tr>
</tbody>
</table>
## DIVISION 10

### SPECIALTIES

### INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10350</td>
<td>FLAGPOLES</td>
<td>1</td>
</tr>
<tr>
<td>10400</td>
<td>SIGNAGE</td>
<td>5</td>
</tr>
<tr>
<td>10450</td>
<td>CONTROL DEVICES</td>
<td>13</td>
</tr>
<tr>
<td>10700</td>
<td>WINDOW WASHING SYSTEMS</td>
<td>15</td>
</tr>
</tbody>
</table>

## DIVISION 15
**MECHANICAL**

**INDEX**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1501</td>
<td>VALVES</td>
<td>3</td>
</tr>
<tr>
<td>1502</td>
<td>FLOW DEVICES</td>
<td>9</td>
</tr>
<tr>
<td>1503</td>
<td>GAUGES</td>
<td>11</td>
</tr>
<tr>
<td>1504</td>
<td>CENTRIFUGAL END-SUCTION PUMPS</td>
<td>13</td>
</tr>
<tr>
<td>1505</td>
<td>PROCESS PIPING – CARBON STEEL</td>
<td>18</td>
</tr>
</tbody>
</table>

**DIVISION 16**
# ELECTRICAL

## INDEX

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16000</td>
<td>ELECTRICAL GENERAL PROVISION</td>
<td>1</td>
</tr>
<tr>
<td>16110</td>
<td>CONDUITS, WIREWAYS AND RELATED ACCESSORIES</td>
<td>12</td>
</tr>
<tr>
<td>16120</td>
<td>WIRES, CABLES SUPPORTING SYSTEMS AND RELATED ACCESSORIES</td>
<td>19</td>
</tr>
<tr>
<td>16415</td>
<td>TRANSFER SWITCHES</td>
<td>25</td>
</tr>
<tr>
<td>16480</td>
<td>MOTOR CONTROL CENTERS (MCC)</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>PANEL TESTING SOP</td>
<td>41</td>
</tr>
</tbody>
</table>
DIVISION 17

LANDSCAPING, PLANTING AND ENVIRONMENTAL WORKS

INDEX

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.01.1</td>
<td>LANDSCAPING AND PLANTING SCOPE</td>
<td>1</td>
</tr>
<tr>
<td>9.01.2</td>
<td>LANDSCAPE PLANTING STANDARDS</td>
<td>1</td>
</tr>
<tr>
<td>9.01.3</td>
<td>PRODUCTS AND MATERIAL</td>
<td>2</td>
</tr>
<tr>
<td>9.01.4</td>
<td>LANDSCAPE PLANTING CONSTRUCTION</td>
<td>11</td>
</tr>
<tr>
<td>9.01.5</td>
<td>MEASUREMENT</td>
<td>18</td>
</tr>
</tbody>
</table>
DIVISION 1

ADDITIONAL GENERAL REQUIREMENTS

In this section, except where items are included in the Bill of Quantities and are priced separately by the Contractor therein, provision of the following are deemed to be included with all work:

1. SITE SURVEY AND SETTING OUT

Before commencing Works on Site the Contractor shall carry out all surveying works of the Site in conjunction with or as instructed by the Engineer's Representative or of such parts or the Site as the Engineer's Representative may direct to record the Site limits, dimensions, ground levels, obstructions and other features and to establish base lines and points for future setting out and to record the basis for measurement of excavation and earthwork, where applicable.

1.1 General Setting Out

Shall be performed using methods and measuring instruments described in BS 5606, and within the permissible deviations within the allowance as agreed with the EIPP's project engineer.

Details of methods and equipment to be used in setting out the Works shall be submitted to the Engineer's Representative.

The Contractor shall inform the EIPP Engineer's Representative when setting out is complete and before Commencing construction and shall provide instruments and assistance for checking the setting out if required by the Engineer's Representative.

1.2 Setting Out Utility Works

Shall be as shown on the Drawings or as instructed on Site. Stake-out shall be revised if, in the opinion of the Engineer's Representative, modification of line or grade is advisable.

1.3 Setting Out Civil Work

Shall be as shown on Drawings or as instructed on site.

1.4 Record Drawings

The Contractor shall record details of all grid lines, existing ground levels, setting-out stations, bench marks and profiles on the site setting-out drawing; retain on the Site throughout the duration of the Contract and hand to the Engineer's Representative on completion.

1.5 All Dimensions and Levels

Both on the Drawings and the Site, shall be checked particularly the correlation between components and the work in place. Materials and components shall not be ordered or work carried out until any discrepancies have been resolved with the Engineer.

2. TEMPORARY WORKS AND SERVICES

2.1 General

The Contractor shall provide all Temporary Works and services and Contractor's Equipment and tools required for the efficient and safe execution of the Works, including but not limited to:

   a) Temporary roads, hard standings, sleeper tracks and the like
   b) Temporary fences, gates and barriers
   c) Temporary offices, stores, latrines and compounds
   d) Scaffold, ladders, hoists, cranes and the like
   e) Transport and vehicles on and off Site
   f) Fixed and movable mechanical plant and equipment
   g) Temporary water and power supplies and site lighting
   h) Temporary drainage.

2.2 Temporary Site Facilities

2.2.1 Roads
Specifications for construction of Vegetable market in Al Qaa Municipality

Permanent roads, hard standings and footpaths on the Site may be used provided they are adequately maintained and thoroughly cleaned and made good after use and left in unimpaired condition.

2.2.2 Diversions
The Contractor shall:

a) Provide temporary detour roads, and other facilities to divert traffic through or around any part of the Works or for maintenance of traffic in locations affected by his works that warrant such temporary works. Location, standard, width, construction and maintenance of detour routes shall be approved by the Engineer's Representative, ensuring at all times that the routes are signed, striped, maintained and furnished with all traffic control devices as shown, directed and/or needed.

b) Submit designs and detailed working drawings of the proposed temporary works for approval by the Engineer prior to commencement of the works. The design live load for temporary bridges related to roads exposed to heavy vehicles shall not be less than the design live load for permanent bridges, or as directed by the Engineer,

c) Where measure are taken for continuously regulating and supervising traffic, provide temporary roads and bridges for one-way traffic.

d) Phase the execution of temporary and permanent works to minimize the disruption to traffic

e) Submit a phased program of temporary works one week before commencement of any part of the works.

2.2.3 Trench Crossings
Trench Crossings are to be provided for free and safe passage or vehicles and pedestrians over pipe trenches.

2.2.4 Temporary Site Fence
The Contractor shall provide a suitably secure temporary site fence where necessary or as directed by the Engineer. The design of the fence is to be submitted to the Engineer for approval.

2.3 Temporary Services

2.3.1 Electricity
The Contractor shall provide electric supply and all equipment for lighting and power for the works and make temporary arrangements for distributing about the Site.

2.3.2 Power
The Contractor shall provide electric power for the Works including supplies for commissioning engineering services and plant, at the required voltages.

2.3.3 Lighting
The Contractor shall provide lighting for the Site and the Works for safety and security to the Works and to facilitate proper execution of work and to illuminate internal surfaces during finishing work and inspection. Spaces designed to be artificially lit during daylight hours are to have temporary illumination similar to that provided by the permanent installation.

2.4 Diversion of Public Utility Services

2.4.1 Temporary Diversion of Existing Public Utility Services
Where execution of the Works involves the temporary diversion of existing public utility services, the Contractor shall perform such temporary diversion and shall maintain the flow or service as directed by the Engineer. Unless otherwise stated the cost will be deemed to be included in the Contract Price.

3. MAINTENANCE OF TRAFFIC AND DETOURS

I SCOPE
A. The work covered in this section includes the supply of all materials, construction of detour roads, bridges and culverts where necessary and installing, operating and maintaining all
required temporary lighting, signing, signals, pavement marking, barriers and other safety measures for the maintenance of vehicular and pedestrian traffic through and around the Works during the Contract Period. These works also include the removal of all unwanted temporary detour items and facilities at the end of the Contract and other related work as shown on the Drawings or directed by the Engineer.

B. This section shall be read in conjunction with the relevant sections of the Safety, Health and Environmental Works contained in Volume 1.

4. MAINTENANCE AND PROTECTION OF TRAFFIC

A. General Procedures

A.1 The Contractor shall ensure the free movement of vehicular and pedestrian traffic and shall maintain all highways including temporary detours and accesses in a clear and safe condition free from obstructions. Adequate access to the site shall be maintained at all times to ensure that traffic on existing roads is not impeded unnecessarily by traffic turning into the Site.

A.2 In order to facilitate movement of traffic through or around construction and when and wherever required by the Engineer, the Contractor shall furnish, erect and maintain signs, traffic barricades and other facilities necessary for safe and efficient direction and handling of traffic at specified locations in or around the site to the satisfaction and approval of the Engineer.

A.3 The Contractor shall, if detailed on the Drawings or instructed by the Engineer, provide flashing signal lights by night and provide sturdy barricades for the protection of workmen engaged on traffic control.

A.4 Where required by the Contract Documents or the Engineer, the Contractor shall provide, erect, operate and maintain temporary traffic signals of the 3-colour type. Signals shall be capable of both automatic and manual operation as required. The timing device of any automatic traffic signal shall be accurate to within plus or minus two seconds.

A.5 Manually operated "stop-go" signs shall only be used if approved by the Engineer.

A.6 Traffic signals, when used, shall be sited on the nearside of the travelled way in positions which shall be clearly visible to on-coming drivers for a distance consistent with safe stopping. Appropriate advance warning signs shall be provided and maintained in a clean condition.

A.7 The Contractor shall, whenever necessary, provide flagmen at specified locations with the sole task of directing traffic through or around the site and shall provide and erect within or near the site any warning or directional signs the Engineer may require.

A.8 All barriers, traffic signs, signals and other such devices shall be erected, maintained and removed when necessary, as directed by the Engineer.

B. One-Way Traffic Operation

B.1 Whenever it becomes necessary to operate one-way traffic along any stretch of road in or around the site, the Contractor shall, for the purpose of maintaining traffic, provide a detour with a traffic lane of not less than 3.5 m wide and shall keep it open to traffic. If construction work is proceeding at more than one location, the Contractor shall carry out his work so as to cause minimum obstruction and delay to traffic and shall be responsible for control of traffic using such detour lanes.

B.2 At locations where traffic is handled along single lane sections and whenever required by the Engineer, movement of the Contractor’s equipment from one part of the site to another shall be in accordance with the traffic regulations and by agreement with the concerned Authorities. Material spilt as a result of hauling operations along or across the highway shall be removed forthwith by the Contractor, failing which the Engineer shall arrange for its removal by others, at the Contractor’s expense.

C. Half Width Construction of Highway
C.1 Where, in the opinion of the Engineer, construction of a detour is inappropriate, new construction shall be limited to half the highway width at a time.

C.2 Details of half width stretches and the timing of construction of each shall be included in the Contractor's Programme for execution of the Works.

C.3 Half width construction shall be kept to the minimum length possible.

7. DAMAGE TO PROPERTY

a. The contractor shall reinstate all public and private property affected by the works, temporary works, construction plant, labor, materials, transport or other activities to a condition equal to or better than that which existed before start of the works.

b. If the contractor fails to reinstate damaged property adequately and promptly, the ILO reserves the right to arrange for repairs by others, or make payments to the owners and occupiers. All such costs incurred shall be deducted from payments due to the contractor.

8. SITE SAFETY NOTICE BOARDS

The contractor shall set up, maintain and remove, when directed by ILO, during the entire contract period, safety notice boards in prominent places on the site for his labor force. These notice boards shall be located in positions approved by ILO such that they are clearly visible to the contractor's employees. The contractor shall select safety signs appropriate to the hazards and relevant emergency contact information and these shall be to the approval of the ILO before manufacture. The contractor shall ensure that appropriate safety signs are maintained as required relevant to the hazards. The contractor’s staff and labor force shall be made fully aware of the safety signs and emergency contact information prior to commencing duties on site.

9 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

a. The contractor and/or his contractor suppliers, shall be responsible to meet ILO' requirements for Quality Assurance and Quality Control stated in this document. They shall ensure strict adherence to the following requirements in the performance of the Works.

b. The contractor shall remain ultimately responsible to maintain Quality Control of all plant, equipment and works performed under the Subcontract including that of his contractor and suppliers.

c. ILO reserves the right to request and conduct additional inspections, tests and/or audits in addition to the requirements stipulated herewith to verify conformance with quality requirements.

d. ILO may audit the contractor and his contractor to verify compliance with the technical specification. Audits may be performed on a systematic basis or as warranted by general quality trends. The contractor shall provide all necessary assistance to ILO during audits.

e. Non-conforming materials, or equipment whether in place or not, will be rejected by ILO. The contractor will be notified in writing to correct or remove the defective material or equipment from the works. If the contractor fails to respond, ILO may order correction, removal, and/or replacement of defective materials or equipment by others. The contractor shall bear all costs for such work.

f. The contractor shall repeat tests and inspections after correcting non-conforming work until all work complies with the requirements. All re-testing and re-inspections shall be performed at no additional cost to ILO.
g. Materials accepted on the basis of a certificate of compliance may be sampled and inspected/tested by ILO at any time. The fact that the materials were accepted on the basis of certificate shall not relieve the contractor of his responsibility to use materials which comply with the specification.

h. If the contractor fails to adequately perform any or all of the provisions of the specification, ILO reserves the right to perform such activities and charge the contractor for the actual cost of such work.

i. The contractor must arrange for factory inspections and tests when required by the technical specification unless otherwise instructed by ILO.

j. The contractor must provide equipment, instruments, qualified personnel and suitable transport acceptable to ILO necessary to inspect the work and perform the tests required by the specification.

k. ILO may elect to perform additional inspections and tests at the place of manufacture, the shipping point, or at the destination, to verify compliance with the technical specification.
   - Inspections and tests performed by ILO shall not relieve the contractor of his responsibility to meet the specification.
   - Inspections and tests by ILO shall not be considered a guarantee that materials delivered at a later time will be acceptable.
   All costs associated with the foregoing shall be borne by the contractor.

l. The contractor must notify the ILO representative in sufficient time to enable him to inspect various areas or aspects of the work while still visible. Such notification shall be given by a written inspection request in a format acceptable to ILO each and every time various areas of the work are to be covered up so as to prevent subsequent inspection. These activities shall be identified as hold points in the contractor’s inspection and test plans.

m. If the contractor does not notify ILO in sufficient time to allow for inspection prior to covering up installations governed by a hold point, the contractor shall remove all such materials/equipment as deemed necessary by ILO to verify compliance of the work. Any delays, additional work or additional costs attributed to the above shall be at the contractor’s expense.

n. The contractor shall establish, equip and maintain a site laboratory capable of conducting various tests as specified herein, unless otherwise approved by ILO. Other tests may be conducted at manufacturer’s laboratories, government laboratories, or independent commercial laboratories as required by the design documents and technical specifications; these tests should be witnessed by ILO.

The laboratory shall be located near the site. As a minimum, the site laboratory shall be capable of conducting the following tests:
   - Temperature of fresh concrete.
   - Slump of fresh concrete.
   - Casting of concrete cylinders (cubes) for compressive strength testing and Hardened density of concrete cylinders (cubes).
   - Curing of concrete specimens.
   - Soil compaction tests.
   - In-situ density test for soils.
   - Moisture content of soils.
   - Sieve analysis.
   The contractor shall develop and submit for approval laboratory procedures for all testing to be conducted on site. The site laboratory shall not service other projects, unless agreed by ILO.
If directed by ILO and as required by the technical specifications, the contractor is obliged to carry out any of the specified testing in a certified independent laboratory acceptable to ILO. The contractor shall bear all cost related to such tests.

ILO’s representative shall supervise and control all the sampling, and testing operations to verify that all the requirements of these specifications are fulfilled.

The minimum frequencies for routine tests shall be as specified in the contractor’s PQP.

10 METHOD STATEMENTS

a. The contractor shall submit method statements for all major activities as designated in the various sections of the specification.

b. In addition to providing a step by step description of the work, method statements shall also clarify the following:
   - Scope of work covered.
   - Contractors utilized.
   - Products required.
   - Tools and equipment required.
   - Prior activities to be completed.
   - Personnel required and designated responsibilities.
   - Safety hazards and precautions to be taken.
   - Quality control measures
   - Procedure, step by step sequence of work.

10 INSPECTION AND TESTS

a) The contractor shall develop and submit for approval, inspection and test plans for all major activities required to complete the works to ensure that all inspections and tests are conducted to confirm compliance with the specification.

b) The inspection and test plans shall be developed to monitor all activities on a step by step basis in sufficient detail to indicate the following:
   - Type of inspection required, surveillance, witness, hold point, etc.
   - Type and frequency of test required.
   - Acceptance or rejection criteria.
   - Reference to records which document compliance.
   - Mechanism to identify which inspections/tests will be verified by ILO or independent inspection agency.

c) Information to be included on Inspection requests:
   - Serial number.
   - Contract or project number.
   - Contractor’s name.
   - ILO’s representative’s name.
   - Specialty (civil, structural, mechanical, other)
   - Inspection or test description.
   - Facility and location.
   - Scheduled time and date for inspection.
   - Signature of contractor with submission time and date.
   - Evaluation block for ILO’s representative with date and time inspected
   - Results of inspection/test, pass, fail, not ready,
   - Permission to proceed, yes or no and
   - ILO’s signature block.
   - General comments.

d) The contractor’s quality control engineer shall assure that all inspection requests are
complete and sent to ILO. Advance copy of the inspection request may be faxed to ILO. Minimum inspection times shall be as follows:

- 24 hours on site.
- 48 hours elsewhere within Lebanon.

e) Inspection and test status.

- Contractor shall clearly document and identify the inspections and test status of materials and equipment throughout construction.
- Identification may be by means of stamps, tags, or other control devices attached to, or accompanying, the material or equipment.
- Report inspection/test failures to ILO immediately upon receipt.

f) Inspection and test records.

- The contractor shall develop and submit inspection and test records in a format acceptable to ILO, to document all inspections and tests listed on the inspection and test plans.
- Inspection and test records shall, as a minimum, identify the following:
  - Name of items inspected/tested
  - Quantity of items.
  - Inspection/test procedure reference.
  - Date.
  - Name of inspector/tester.
  - Observations/comments.
  - Specified requirements.
  - Acceptability.
  - Deviations/non-conformances.
  - Corrective action.
  - Evaluation of results.
  - Signature of authorized evaluator.
DIVISION 2

SITE WORK

EXCAVATION & EARTHWORK (02200)

A. **Scope**

1. This Section specifies materials and workmanship for Excavation and Earthworks.

   *Note:* The general bulk excavation and retaining structure works have been carried out in a separate Contract. Work under this Contract shall comprise further excavation for foundations under water table.

2. Items included are methods and accuracy of excavation, shoring, protection of Works, backfilling, disposal of surplus material, making up levels, compacted fill, poor ground and excavation in rock, and maintaining excavation and earthwork free from water.

3. The Contractor shall check the existing reduced levels and carry out further excavation for foundations to the required depths under water table shown on the drawings and as directed by the Engineer.

4. Included also under this section the requirements for dewatering system.

B. **Performance and Standards**

1. The Excavation and Earthwork shall be carried out to the dimensions shown on the drawings taking full account of existing ground, permanent water table, periods of rainfall, and all matters relevant to this section of the Works.

2. All materials and workmanship shall comply with the latest edition of relevant British Standards and with the Specification. In particular the recommendations of BS 6031 shall be complied with.

3. Relevant Standards.

   Testing of Soils: in accordance with BS 1377.
   Earthworks: in accordance with BS 6031.

C. **Related Items**

01060 Regulatory Requirements
03300 Cast-In-Place Concrete
EXCAVATION & EARTHWORK (02200) (CONT'D)

D. **Submitals**

1. The Contractor will be required if requested to submit his detailed proposals for materials and methods to be used in carrying out the work, and these must be approved by the Engineer before work commences. Items included are:

   1. Details of plant and equipment
   2. Proposed sequence of Works
   3. Proposals for ensuring stability of excavations
   4. Proposals for maintaining excavation free of standing water
   5. Number of passes and depth of layers for compaction of fill
   6. Proposals for dewatering system
   7. Proposals for excavation under water table.

E. **Product Handling**

1. **General**

   The Contractor shall make his own arrangements for shoring, stockpiling and for the provision of Sites for the purpose.

   All excavated materials shall be removed from the site by suitable means approved by the Engineer to approved dumps.

F. **Materials**

1. **Definition and Classification of Earthworks Materials**

   The Engineer will determine the classification of Excavation and Earthworks materials in accordance with the definitions hereinafter.

   'Suitable Material' shall comprise all material which in the opinion of the Engineer is acceptable for use in the Works.
EXCAVATION & EARTHWORK (02200) (CONT'D)

F. Materials (Cont'd)

1. Definition and Classification of Earthworks Materials (Cont'd)

'Unsuitable Material' shall mean other than suitable material and shall include:

(i) logs, stumps and perishable materials.
(ii) running silt.
(iii) slurry or mud.
(iv) highly organic clay or silt.
(v) clay having a liquid limit exceeding 90 and/or a plasticity index exceeding 65.
(vi) material having a moisture content outside the limits of moisture content specified either when excavated or thereafter.
(vii) material susceptible to spontaneous combustion.

'Rock' shall mean any hard natural or artificial material requiring the use of blasting or other special machines or tools for its removal, but excluding individual masses less than 0.1m³ in trenches and 0.2m³ in general excavation.

G. Workmanship

1. Site and Sub-soil Conditions

The Contractor shall be fully responsible for ascertaining all Site and sub-soil conditions affecting the excavations and Earthworks. These shall include but not be limited to information concerning the nature of the ground and periods of rainfall.

The Contractor shall satisfy himself that the reduced levels as indicated on the drawings are correct and shall bring to the attention of the Engineer any levels considered to be in error before disturbing the affected ground.

The Contractor shall refer to general notes stated on drawing S00 and the geotechnical report concerning the nature of ground and follow the Engineer's recommendations for soil strengthening of any possible ground cavities.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. **Workmanship (Cont'd)**

2. **Methods**

   The methods adopted for the Excavation and Earthworks shall be determined by the Contractor.

   The Contractor shall carry out the work in whatever material may be encountered and shall use such methods and provide and operate such plant and equipment as may be necessary to deal with every class of material.

   The use of explosives is strictly forbidden in carrying out the works.

   Before commencing any excavation or earthwork the Contractor shall if requested submit his proposals for performing the work and obtain the Engineer's approval. The proposals shall include details of the plant and equipment to be used and the method and sequence of carrying out the work.

3. **Dimensions**

   The Contractor shall carry out the excavation and earthworks to the dimensions and profiles necessary for the proper construction of the Works shown on the drawings or as instructed by the Engineer.

   In the event of excavations being made larger than the sizes shown on the drawings or as instructed by the Engineer, the Contractor shall fill in the excavated void to the correct profile using material as specified hereinafter or as directed by the Engineer.

4. **Protection of Personnel etc.**

   The Contractor shall take such precautions as are necessary to ensure the protection of personnel on or adjacent to the Site and the maintenance and protection of any adjacent property, structures or roads.

5. **Stability**

   The Contractor shall ensure the stability of all excavations and Earthworks by the provision of suitable means or shoring system as may be necessary. Should any slips, falls or settlement occur they shall be made good by the Contractor using methods and materials approved by the Engineer.

   Before commencing any excavation or earthwork the Contractor shall if requested submit his proposals for ensuring its stability and obtain the Engineer's approval.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. Workmanship (Cont'd)

6. Maintaining Excavation and Earthworks free from Water

The Contractor shall arrange the rapid disposal of water shed onto or entering the excavations or earthworks from any source at any time during the construction.

In pumping out excavations the Contractor shall ensure the stability of all structures, excavations and earthworks.

Before commencing any excavation or earthwork the Contractor shall if requested submit his proposals for maintaining the Works free from standing water and obtain the Engineer's approval.

7. Excavation of Cuttings

Where unsuitable material is encountered in the sub-grade it shall be excavated to such depths and over such areas as may be directed by the Engineer and be run to spoil. The resultant excavation shall be backfilled with suitable material deposited and compacted as specified.

Materials used in areas of fill shall be compacted such that at least 9 out of every 10 consecutive samples taken of the dry density. Under paving, ground slabs or foundations for structures the following dry densities shall be obtained except where directed otherwise by the Engineer:

(i) For the topmost 600mm below formation level, 95% of maximum laboratory density.

(ii) For the remainder below formation level 90% of maximum laboratory density except where directed otherwise by the Engineer.

8. Completed Earthwork

Formation to paving and the foundations for structures shall be properly shaped to the required levels and parallel to the required finished surfaces. The level of any point on the formation and the line of any edge of the formation shall conform to that shown on the drawings within the following tolerances:

Tolerance from true Surface level
Paving : + or - 50mm
Foundation for structures : + or - 25mm
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. Workmanship (Cont'd)

8. Completed Earthwork (Cont'd)

Tolerance from true
Plan position
Paving : + or - 50mm
Foundation for structures : + or - 50mm

Where the Earthworks provide the final surface the accuracy of profile must be such as to avoid ponding and to be consistent with adjacent constructions, but in any case each point shall be within plus 100mm of the specified line and level.

9. Preparation and Surface Treatment of Formation Beneath Ground Bearing Slabs and Paving

Preparation and surface treatment of the formation shall be carried out only after completion of any sub-grade drainage, and unless otherwise agreed by the Engineer, immediately prior to laying the sub-base.

Where unsuitable material is encountered in the sub-grade it shall be excavated to such depths and over such areas as may be directed by the Engineer and be run to spoil. The resultant excavation shall be backfilled with suitable material deposited and compacted as specified.

10. Excavation for Foundation

The sides of excavation shall be adequately supported at all times. Except where shown on the drawings or otherwise permitted by the Engineer they shall not be battered.

Excavation shall be kept free from water in accordance with Clause G.6.

The bottoms of all excavations shall be formed to the lines and levels shown on the drawings. Any cavities or pockets of soft soil or loose rock in the bottoms of the excavation shall be removed and the resulting cavities and any large fissures and cavities shall be treated as stated in the soil investigation report to the approval of the Engineer.

All excavated materials from the excavations not required for refilling shall be disposed off in accordance with the requirements of Clause E.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. Workmanship (Cont'd)

10. Excavation for Foundation (Cont'd)

Immediately prior to placing concrete in an excavation the bottom shall be leveled and compacted. The Contractor shall notify the Engineer when excavations are complete and ready to receive concrete, and shall obtain the Engineer's approval before concreting commences. Concrete shall be placed within 24 hours of receiving such approval, otherwise fresh approval shall be sought and obtained from the Engineer before proceeding with this work.

The Contractor shall make good with suitable material or Plain-in-situ concrete as directed by the Engineer the following:

(i) Any excavation greater than the net volume required for the Works;

(ii) Any additional excavation at or below the bottom of foundations to remove material which the Contractor allows to become unsuitable.

11. Refilling of Foundation Excavations

Refilling of foundation excavations shall not be carried out until the foundations and structure within the excavations have been inspected and approved by the Engineer.

Unless otherwise shown on the drawings or directed by the Engineer, all fillings for this purpose shall consist of suitable material as defined in Clause F.1, deposited and compacted as specified.

Timber sheeting and other excavation supports shall be removed as the filling proceeds except where they are required by the drawings or the Engineer to be left in position. The removal of such supports will not relieve the Contractor of his responsibilities for the stability of the Works.

12. Granular Fill to Structure

Where shown on the drawings or directed by the Engineer granular fill shall be placed and compacted against earth retaining structures. Such granular fill shall consist of well graded crushed or uncrushed gravel, stone, rock fill, crushed concrete or natural sand, or a combination of these. It shall not contain unsuitable material as defined in Clause F.1.

Not less than 95 percent of the material shall pass a 125mm BS sieve and at least 90 percent shall pass the 75mm BS sieve.

Up to 5 percent of the material may be made up from isolated boulders not exceeding 0.15m³ in size provided not the fill can be compacted in the manner specified.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. **Workmanship (Cont'd)**

13. **Fill Behind Retaining Walls**

Backfill behind retaining walls where working space is available, shall be backfilled after providing sufficient bracing by ground floor slabs. The fill material shall be well graded and compacted to at least 95% of the maximum dry density as determined by the modified AASHTO compaction test.

14. **Granular Sub-Base Under Ground Bearing Slabs**

Where shown on the drawings or directed by the Engineer granular sub-base shall be deposited and compacted beneath ground bearing slabs.

The sub-base material shall be granular sub-base material passing of 150mm BS sieve. It shall be well compacted using a vibratory roller or other approved method.

The surface of the compacted sub-base shall be blinded with fine granular material to produce a smooth level surface.

15. **Explosives and Blasting**

The Contractor shall not make use of any explosives in the course of excavations in this project.

16. **Probing and Filling of Possible Cavities**

The Contractor shall examine the underlaying bedrock within the area of the proposed structure by probing to determine the presence and extent of cavities. The probing method shall be as described in the geotechnical report. In case any cavities are encountered then ground treatment shall be executed by the Contractor as described in the geotechnical report and as directed by the Geotechnical Engineer; all to the satisfaction and approval of the Engineer.

17. **Dewatering**

a. Water table is expected approximately at 250mm below the levels reached by first stage excavation which has been executed under a separate contract. The Contractor shall provide dewatering system to keep the water level well under the final excavation levels.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. Workmanship (Cont'd)

17. Dewatering (Cont'd)

b. The Dewatering system shall include the following:

i. Design the dewatering system to maintain the water at the required levels, without interruption, until completion of foundations and site services and until such time as the completed portions of the works are sufficient to offset the floatation effect of the water.

ii. The Contractor shall provide and maintain pumps, well points, suction and discharge lines and other dewatering system components necessary to convey water away from the excavations.

iii. The dewatering system shall comprise well screened sumps or well points. Sumps shall be strategically located, not closer than 3m from the nearest edge of foundation. No surface pumping is allowed.

iv. The Contractor shall lower the water table, if present to 100cm below foundation level and keep the site dry, during the whole construction period.

v. The Contractor shall prevent surface water and subsurface or ground water from entering the excavation, from ponding on prepared subgrades and from flooding project site and surrounding area.

vi. The Contractor shall protect subgrades from softening and from damage by water accumulation.

vii. Sink Holes: The Contractor has to allow for the construction of sinkholes, to collect any possible seepage and pump it away.

viii. The Contractor shall submit to the Engineer a detailed description of his proposed works and methodology to control ground water to a level at least 100cm below bottom of foundation. The Contractor shall be responsible for provision and installation of pumps to the satisfaction of the Engineer. The Contractor should conduct his own field testing to evaluate the soil permeability in order to determine grouting (if required) and pumping characteristics.
EXCAVATION & EARTHWORK (02200) (CONT'D)

G. **Workmanship (Cont'd)**

17. **Dewatering (Cont'd)**

b. The Dewatering system shall include the following: (Cont'd)

ix. The efficiency of the ground water control will be tested by the Contractor by performing a minimum of one “Lugeon” test per 1000 m² area of the site pump tests, before the excavation is started, subject to the satisfaction of the Engineer.

c. The Contractor shall obtain permission for disposal of water from dewatering into the municipality or SOLIDERE drainage systems.

d. Maintain the dewatering system as long as it is required.

Provide sufficient maintenance staff to ensure continuous working.

Provide a network for the wells for pumping water.

Remove temporary works on completion.
HARD LANDSCAPING (02515)

A. **Scope**

1. The Contractor shall furnish and install all hard landscaping as shown on the drawings.

2. Work of this section shall include, but not limited to the following:
   a. Reconstituted stone paving tiles
   b. Granite paving tiles
   c. Basalt paving tiles
   d. Precast concrete curb stones.

B. **Submittals**

1. **Shop Drawings**
   a. The Contractor shall prepare and submit complete shop drawings of the work included herein for the Engineer's approval. Shop drawings shall include profiles and sizes. Shop drawings shall be submitted as directed by the Engineer.
   b. All installed materials shall conform to the approved corresponding shop drawings.

2. **Samples**
   a. Samples of materials proposed to be used, shall be submitted by the Contractor for Engineer's approval. Samples shall indicate finishes proposed to be used and shall be submitted on material on which they will be applied. Samples shall be submitted as directed by the Engineer.
   b. All installed materials shall conform to the approved corresponding samples.

3. **Field Mock-Up**
   a. Field mock-up shall be performed at the site where directed by the Engineer. The field mock-up shall be of sizes directed by the Engineer. The field mock-up shall indicate the sizes, colour and finish of each product for pavers, curbstones, and basalt tiles, etc...
HARD LANDSCAPING (02515) (CONT'D)

B. **Submittals (Cont'd)**

3. **Field Mock-Up (Cont'd)**

   b. The field mock-up shall be immediately revised by the Contractor during the presence of the Engineer, if the Engineer so directs, until the field mock-up is approved by the Engineer. All installed materials shall conform to approved corresponding field mock-up. The field mock-up shall remain intact until its removal is directed by the Engineer, and subsequently, shall be removed by the Contractor.

4. **Measurements**

   a. The Contractor shall take all necessary measurements at the building as required to assure proper installation of the work of this section.

5. **Coordination**

   a. All work of this section shall be closely coordinated with the work of other sections whose work affects or is affected by the work specified in this section.

C. **Related Items**

   03300 Cast-In-Place Concrete
   03500 Beds and Screeds

D. **Materials**

1. **General**

   a. **Cement**

   Conforming to BS 12 - ASTM C150 type I, non staining.

   b. **Aggregate (Fine and Coarse)**

   Conforming to BS 882 - ASTM C33 of material, colour and proportions conforming to approved sample. Aggregate shall be clean, hard, strong, durable, inert materials, free of deleterious substances.
HARD LANDSCAPING (02515) (CONT'D)

D. **Materials (Cont'd)**

1. **General (Cont'd)**
   
c. **Water**
   
   Clean and free from injurious amounts of oils, alkalis, organic materials, and other deleterious substances and shall comply with the requirements of BS 5328.

d. **Air-Entrainment Admixture**
   
   Shall be approved by the Engineer.

2. **Reconstituted Stone**
   
a. Shall be 30mm thick of same materials used for sidewalks in BCD area. Any other alternative shall be as directed by the Engineer. The materials shall have the following typical physical properties:

<table>
<thead>
<tr>
<th>Properties</th>
<th>ASTM Test</th>
<th>ANSI Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption</td>
<td>ASTM C373</td>
<td>Porcelain 0.5%</td>
</tr>
<tr>
<td>Scratch Resistant</td>
<td>MOHS Hardness Test</td>
<td>No Standard</td>
</tr>
<tr>
<td>Bond Strength</td>
<td>ASTM C482</td>
<td>Greater than 50 PSI</td>
</tr>
<tr>
<td>Static Coefficient of Friction Matt Flooring</td>
<td>ASTM C1028-89</td>
<td>0.6</td>
</tr>
<tr>
<td>Breaking Strength</td>
<td>ASTM C648</td>
<td>Greater than 250 lbs</td>
</tr>
</tbody>
</table>

b. **Pigemnet: shall conform to ASTM C979.**

c. **Joints: shall be filled with coloured grout.**

d. **Paving tiles may be obtained from a locally available paving producer.**

e. **Testing of units for conformance with strength requirements shall be performed by the Contractor to the satisfaction of the Engineer.**

f. **Finish: shall be rough without pits, fins, voids, or cracks.**

g. **Colour: shall be to the approval of the Engineer.**

h. **Bedding material: One part cement and four parts fine aggregate/sand.**
HARD LANDSCAPING (02515) (CONT'D)

D. **Materials (Cont'd)**

3. **Granite Paving Tiles**
   a. Granite paving tiles shall be "Noir Mouchte Flame" conforming to the specifications in section 09620 and shall be sound, free from holes, seams, shakes, clay pockets and other defects which would impair the strength, durability or appearance of the work.
   
   b. Size: as shown on drawings and as indicated in Bill Items.
   
   c. Colour: Grey or as directed by the Engineer.
   
   d. Finish: Flamed without pits, fins, voids or cracks.
   
   e. Bedding material: One part cement and four parts fine aggregate/sand.
   
   f. Pigment: shall conform to ASTM C979.
   
   g. Joints: shall be filled with coloured grout.

4. **Basalt Paving**
   a. Basalt paving shall be with even rough surface without pits, fins, voids, or cracks, shall be quarried from natural sources and shall have the following characteristics:
      - Compressive length: 35800 psi according to ASTM C170.
      - Density: 190 according to ASTM C97.
      - Absorption by weight: 0.05% according to ASTM C97.
      - Abrasion resistance: 0.026” according to ASTM C241.
   
   2. Testing of units for conformance with strength requirements shall be performed by the Contractor to the satisfaction of the Engineer.
   
   3. Size: as indicated on drawings and bill items
   
   4. Colour: Dark grey or as directed by the Engineer.
   
   5. Finish: Basalt tiles shall be split finished from all sides or as otherwise directed by the Engineer.
   
   6. Bedding material: One part cement and four parts fine aggregate for floor paving and one part cement and four parts of sand for cladding and steps.
   
   7. Joints: shall be filled with coloured mortar.
HARD LANDSCAPING (02515) (CONT’D)

D. **Materials (Cont’d)**

5. **Curb Stones**

   a. Curbstones shall be high density precast concrete units manufactured to 1/8” tolerances obtained from locally available paving producer and shall have the following characteristics:

   - Average compressive strength of 800 psi with no individual unit under 720 psi.
   - Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C140.
   - Resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C67.

   b. Sizes: as indicated on the drawings and Bill items.

   c. Finish: Fairface smooth without pits, fins, voids or cracks.

   d. Bedding material: One part cement and four parts sand.

   e. Joints: Knife edge mortar-less joints.

E. **Workmanship**

1. **Examination of Surfaces and Conditions**

   a. All surfaces which will receive the work of this section and all conditions which affect the work of this section shall be carefully examined by the Contractor prior to installation of the work of this section. Starting installation on any surface shall be construed as an acceptance of such surface and acceptance of all prevailing conditions, and as a waiver of any subsequent claim to the contrary.
HARD LANDSCAPING (02515) (CONT'D)

E. Workmanship (Cont’d)

2. Installation

   a. All paving and curbstones shall be installed in setting bed of cement mortar as indicated on the drawing. Setting bed shall consist of one (1) part of grey Portland Cement to four (4) parts sand or fine aggregate.

   b. Surfaces to receive cement mortar shall be dry and thoroughly cleared of all dirt, paint and other materials which may adversely affect the bond of the setting bed.

   c. Pavers shall be installed level to falls unless shown otherwise on the drawings, with adjacent faces flush, and joints straight and aligned on dry cement and sand bed and compacted on completion.

   d. Cement grouting shall be laid on completion to concrete paving and curbstones. Granite pavers shall not be grouted on completion but joints shall be filled with coloured mortar.

   e. Patterns of laying paving tiles shall be as directed by the Engineer.

3. Protection

   All work of this section, and related adjacent construction, shall be protected from damage, staining, or other imperfections at all times. Damaged, stained, or imperfect materials shall be repaired or replaced as directed by the Engineer's without cost to the Employer.

4. Cleaning

   All exposed surfaces of the work of this section and related adjacent surfaces shall be maintained in a clean condition, and upon substantial completion of the Contract shall be thoroughly cleaned to the satisfaction of the Engineer.
SOFT LANDSCAPING (02900)

A. **Scope**

This section specifies materials and workmanship for plants, trees, shrubs and grass in built-in or in independent planters.

REFER TO SCHEDULE OF SOFT LANDSCAPING ITEMS AT THE END OF THIS SECTION.

B. **Performance and Standards**

The water requirements and irrigation shall be to the approval of the Engineer.

C. **Related Items**

Not used

D. **Submittals**

The Contractor will be required if requested to submit his detailed proposals for materials and methods to be used in carrying out the works, and these must be approved by the Engineer before work commences.

E. **Product Handling**

The product handling shall be to the approval of the Engineer.

F. **Materials**

1. **Soil for plantation**

   After the general filling, at the location of the vegetals, a hole or a trench will be dug out and filled with a suitable material for plant growth on all the depth.

   After some time, the roots will escape of the hole and develop in the surrounding fillings.
SOFT LANDSCAPING (02900) (CONT’D)

F. Materials (Cont'd)

1. Soil for plantation (Cont'd)

If earth taken on a natural culture soil is not available, this soil will have the following characteristics;

- A well-balanced mixture of sand, clay and calcareous components (15 to 20% of clay, 35 max. of coarse sand: total calcareous content not exceeding 10%) without pebbles over 50mm.

- Water retention capacity (field capacity) 20% min.

- Electrical conductivity, measured in the 1/5 aqueous extract 1 millisiemens/cm/cm²

- Exchangeable sodium percentage not exceeding 5%.

- The pH of the plantation tilth will be brought to about neutrality (between 6.5 and 8)

- The soil for plantation shall be mixed with peat at the rate of one compressed ball of 7.5 cubic feet per 5 cubic metres. Eventually, another organic matter may be used in the same proportion (manure,...)

2. Peat

Peat moss shall be a natural product of sphagnum moss or sedge peat. It shall be free of any foreign matter such as stones of lumps. The peat must be able to pass through a 1.25 centimetre screen. Peat shall contain not less than 70% organic matter by weight on an over dry basis.

3. Fertilizers to be used before planting

The fertilizer to be used for preparing the soil mix is a 0.15.15 type or similar (0% of nitrogen; 15% of phosphorus as P205; 15% of potash as K20).
F. **Materials (Cont'd)**

4. **Fertilizers to be used at plantation and during upkeep**

In order to satisfy the needs during the growth, it is necessary to add a slow acting fertilizer bringing nitrogen, phosphorus, potash, magnesium and trace-elements.

Different mixtures N.P.K.Mg are available for trees, bushes and climblings, and for greens or flowers,

<table>
<thead>
<tr>
<th>For instance</th>
<th>For trees</th>
<th>For greens</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>16%</td>
<td>20%</td>
</tr>
<tr>
<td>P2O5</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>K2O</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>MgO</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

5. **Stakes**

Stakes shall be of sound new hard wood, free of knot holes and other defects and be least 3 metres long.

6. **Vegetals**

a. **General**

All the plants must be chosen in the nursery among the best and fast growing specimens. When delivered in containers, the larger the best.

b. **Quality of trees and shrubs**

The plants supplied shall have the following qualities:

- Be of the requested kind and species in a local variety according to the type.
- Be free of animal and vegetal parasites.
- Be free of biological diseases which could harm their growth.
- Have a well developed root system.

- Be grown in containers of adequate size and be delivered in their containers. At planting time, root bound specimens will be rejected.
F. **Materials (Cont'd)**

6. **Vegetals (Cont'd)**

b. **Quality of trees and shrubs (Cont'd)**

The plants supplied shall have the following qualities: (Cont'd)

- All plants which have been transplanted in nurseries shall have been left undisturbed for at least one growing season after transplantation and must be ready for final planting.

- Plants shall come from local nurseries or nurseries in arid countries so that they are acclimatized to the special climate and soil conditions.

- All the specimen of a group of one specie must be of the same age and development, especially for trees in rows.

c. **Quality of flower plants and ground cover material**

Flower plants or ground cover material shall have the same qualities as trees and shrubs. They may be planted in containers; one or two year old plants will be accepted.

d. **Supply and storage of plants on the site**

It is important that definitive plantation happens as soon as plants leave the nursery. The plants will be delivered according to the possibility of plantation, specially the plants with bare roots. While transported, the plants will be protected against sunshine and draught, in a moist atmosphere.

If they cannot be planted immediately, they will be protected against sunshine, their roots covered with earth, and watered.

All plants being damaged or having suffered from dryness at their arrival on the site will be rejected.

The Contractor is not allowed to change a fixed variety without the approval of the Engineer.

The choice of the nursery and purveyor will need the approval of the Engineer.
SOFT LANDSCAPING (02900) (CONT’D)

F. Materials (Cont’d)

6. Vegetals (Cont’d)

d. Supply and storage of plants on the site (Cont’d)

The Engineer will be informed several days ahead of the arrival of the plants on the site.

G. Workmanship

1. Forms and size of vegetals

Young plant (flowers, climblings)

Vegetal at the beginning of its growth, resulting from seed-plot, layer, cutting, splinter, grafting or any other way or reproduction or multiplication, younger than two years old.

Tuft

Plant presenting at least 3 strong branches, the lowest one close to the ground or close to the grafting.

High stem

Tree presenting a cylindric trunk 2-3m high over lopped by a whole of several branches called head or crown.

The size of a stem is indicated by the circumference of the stem in centimetres, one metre above the ground level.

2. Soil preparation before planting

Plantations will be made in a drained soil.

The natural ground before filling must be decompacted on 30cm at least; then good quality fillings may be brought.

The general soil preparation for all plantations, consists of:

- a preliminary irrigation to bring the soil to a state of moisture suited for tilling.
SOFT LANDSCAPING (02900) (CONT'D)

G. Workmanship (Cont'd)

2. Soil preparation before planting (Cont'd)

   - supply and spreading peat as indicated before:
     * one 7,5 cubic feet compressed ball per plant, mixed in 5 cubic metres for isolated plant
     * one compressed ball for 10m², mixed on 50cm depth for grass or ground covers

   - supply and spreading of a mineral fertilizer, including for each isolated plant or for 10m² grass or ground cover, or 10m of hedges:
     0,200 kg of potash (K20)
     0,200 kg of phosphate (P205)
     tilled and mixed with the soil on 50cm.

   - superficial ground crumbling and raking.

3. Fertilizers added when planting

   When planting, add and mix with the top soil the slow acting fertilizer in order to bring 0,100kg Nitrogen per tree or per 10m² green, and all other nutrients.

4. Plantation of young plants and tufts

   These plantations may be done:

   - in clumps of one or several species, at the density indicated on the plantation plan

   - in hedges (distance between two plants: 0,70m)

   - along walls with climbing plants (distance between two plants: 1,50m)

   Once the ground is prepared, plants shall be planted mixed or not in density according to the indications of the plantation plan.

   Plants supplied bare-rooted will be planted in a hole spade size, their roots will spread after being plunged in liquid mud; the hole will then be filled up with fine earth and slightly compacted.
SOFT LANDSCAPING (02900) (CONT'D)

G. Workmanship (Cont'd)

4. Plantation of young plants and tufts (Cont'd)

Specimens supplied in containers will be planted unwrapped, the clod intact, in a hole of adequate size.

Plants will be put at the same depth as they were in the nursery. Grafted specimens will be planted so that graft will be at 10cm above the ground level after plantation.

After plantation, the ground will be horizontally raked and leveled. An abundant watering will immediately follow the plantation.

5. Plantation of isolated trees

a. High-stems

This paragraph concern trees.

Once the soil prepared as explained precedently, with peat and fertilizers, the high-stems will be plated in a cubic hole of 0,60m size, according to clod if any.

before planting, roots of all bare-rooted specimens will be soaked in liquid mud.

Their roots will be well spread in the hole, and covered with fine earth slightly compressed.

Specimens supplied in containers will be unwrapped and planted carefully so the clod remains intact.

Plants will be planted at the same depth as in the nursery.

Plants will be supported:

- bare-rooted plants by a vertical support sunken at least until the bottom of the hole, and attached at two points by flexible strings not too tightened.

- plants supplied in containers by an oblique support to avoid damage of the clod, and attached as above.

An abundant watering will immediately follow plantation.
SOFT LANDSCAPING (02900) (CONT'D)

G. **Workmanship (Cont'd)**

6. **Guarantee**

The Contractor guarantees the growth of plantations.

He obliges himself to replace free of charge all plants that would die before the end of the "Period of Maintenance".

7. **Schedules**

Refer to following page for Schedule of Soft Landscaping items.
DIVISION 3

CONCRETE WORK

CONCRETE MATERIALS (03010)

A. **Scope**

This section specifies Concrete mixes for all Concrete Work shown on the drawings.

B. **Performance and Standards**

All materials shall conform the requirement of ACI-318-99 or BS8110, whether referred to in this section or not, and shall be to the complete satisfaction of the Engineer.

C. **Related Items**

Concrete Formwork 03100
Concrete Reinforcement 03200
Cast-in-place Concrete 03300
Beds and Screed 03500
Masonry Mortar 04100

D. **Submittals**

The Contractor shall follow the requirements in section 03300 Clause D regarding preparation of trial mixes, testing, and other submittals.

E. **Product Handling**

Storage and handling of materials shall be in accordance with the requirements of section 03300 Clause E.

F. **Materials**

Concrete mixes and materials shall be in accordance with the requirements below, and shall conform with the relevant items specified in section 03300 Cast-in-place Concrete.
## CONCRETE MATERIALS (03010) (CONT'D)

### F. Materials (Cont'd)

Plain In-Situ Concrete

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Strength tested on cylinder</td>
<td>140 Kg/cm²</td>
</tr>
<tr>
<td>(Minimum required cylinder crushing strengths at 28 days)</td>
<td></td>
</tr>
<tr>
<td>Permitted Cement Types</td>
<td>BS12 - ASTM C150 - Type I</td>
</tr>
<tr>
<td>Permitted Aggregate Types</td>
<td></td>
</tr>
<tr>
<td>Coarse</td>
<td>BS 882, 1201 - ASTM C33</td>
</tr>
<tr>
<td>Fine</td>
<td>BS 882, 1201 - ASTM C33</td>
</tr>
<tr>
<td>Nominal Aggregate Max. Size</td>
<td>25mm</td>
</tr>
<tr>
<td>Minimum Cement Contents</td>
<td>250 Kg/m³</td>
</tr>
<tr>
<td>Max. Free Water/Cement Ratio</td>
<td>0.55</td>
</tr>
<tr>
<td>Air Content</td>
<td>4% Optional</td>
</tr>
</tbody>
</table>
CONCRETE MATERIALS (03010) (CONT'D)

F. Materials (Cont'd)

Reinforced Concrete

Mix Strength tested on cylinder (Minimum required cylinder crushing strengths at 28 days) 280 Kg/cm²

Permitted Cement Types  BS 12 - ASTM C150 - Type v
(Sulphate resisting) for foundations only

and

BS 12 - ASTM C150 ordinary cement Type I
For all other members

Permitted Aggregate Types

Coarse  BS 882, 1201 - ASTM C33
Fine    BS 882, 1201 - ASTM C33

Nominal Aggregate Max. Size  20mm

Minimum Cement Contents  350 Kg/m³

Max. Free Water/Cement Ratio  minimum or maximum 0.45 depending on water reducing agent

Max. Cement Content  550 Kg/m³
CONCRETE FORMWORK (03100)

A. **Scope**
   
   1. This section specifies formwork for all Concrete Work indicated as in-situ Concrete on the drawings.
   
   2. Items included are design and construction of formwork, stability, surface finish achieved, cleaning, cast-in fixings and striking times.

B. **Performance and Standards**
   
   1. Formwork shall be constructed to maintain the correct positions, shape, profile and surface finish of the Concrete in accordance with the following standards and this Specifications.
   
   2. Formwork shall satisfy the requirements and comply with the recommendations of ACI347, 304 and 318, BS 8110: Part 1, ISO 3443 and BS 5606 for tolerances in buildings.

C. **Related Items**

   Cast-in-Place Concrete 03300

D. **Submittals**
   
   1. Submit shop drawing for all formwork showing locations of tie bolts and cones, openings, chamfers, inserts, fittings and accessories for the approval of the Engineer.
   
   2. All formwork to be erected using cones and tie bolts for securing the formwork.
   
   3. Electrical, Mechanical and plumbing reservation, coordination drawings before concreting.

E. **Product Handling**
   
   The formwork shall be so handled and erected that the concrete shall not suffer due to defects or damage to the formwork.
CONCRETE FORMWORK (03100) (CONT'D)

F. Materials

1. Ordinary Formwork

This shall be obtained by the use of properly designed formwork or moulds of closely jointed sawn boards. The surface shall be free from voids, honeycombing or other large blemishes.

2. Fairface and Smooth Finish Formwork

This finish shall be obtained by the use of properly designed forms of closely jointed type plywood or other boards where indicated on the drawings. The surface shall be free from voids, honeycombing or blemishes. The surface shall then be improved by carefully removing all fins and other projections.

3. Chamfers and grooves

The chamfers and grooves shall be obtained by wrought hardwood fillet of size and location indicated on the drawings.

All slabs, drop beams and columns shall have chamfers and grooves where shown on the drawings.

4. Form ties

The ties for securing forms for ordinary formwork and for fairface plywood works shall be tie screws with removable plastic cones and removable bolts. When forms are removed, no metal shall be closer than 40mm from the concrete surface.

5. Form coating

Form coating shall be of a type which does not import any stain to concrete nor interface with the adhesive of any finish, sealant, waterproofing material applied to any concrete surface and which has been approved by the Engineer.
CONCRETE FORMWORK (03100) (CONT'D)

G. Workmanship

1. Design and Construction

The design and construction of formwork shall be carried out by competent persons employed by the Contractor, taking due account of the surface finish required.

The formwork shall be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and for the appropriate method of placing and compacting.

Formwork (including supports) shall be sufficiently rigid to maintain the forms in their correct position, shape and profile within the limits of the dimensional tolerances specified in Table 293 of BS 5606 or in ACI117. The supports shall be designed to withstand the worst combination of self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental dynamic effects caused by placing, vibrating and compacting the concrete.

The Contractor shall make allowance for any settlement or deflection of formwork that is likely to arise during construction, so that the hardened concrete conforms accurately to the specified line and level.

The formwork shall be so arranged as to be readily dismantled and removable from the cast concrete without shock, disturbance or damage. Where necessary, the formwork shall be so arranged that the soffit form, properly supported on props only, can be retained in position for such period as may be required by maturing Conditions or Specification.

Approval of the formwork by the Engineer before concreting shall not relieve the Contractor of his responsibility to produce concrete with the Tolerances specified in 03310.

2. Form Lining

The type and treatment of any lining (plywood, metal, plastics etc.) to the forms shall be appropriate to the concrete finish required.

3. Cleaning and Treatment of Forms

All rubbish shall be removed from the interior of the forms in contact with the concrete. Forms shall be clean and treated with a suitable release agent, where applicable.
CONCRETE FORMWORK (03100) (CONT’D)

G. Workmanship (Cont’d)

4. Projecting Reinforcement, Fixing Devices

Where holes are needed in forms to accommodate projecting reinforcement or fixing devices, care shall be taken to prevent loss of grout when concreting or damage when demoulding.

5. Cast-In Fixings

Allowance shall be made to accommodate cast-in fixings as shown on the drawings or where directed by the Engineer.

6. Striking of Formwork

a. General

The removal shall be done in such a manner as not to damage the concrete, and shall take place at times to suit the requirements for its curing and to prevent restraint that may arise from elastic shortening, shrinkage or creep.

After striking of formwork no deviation in the true line between the concealed beams and slabs shall be noticeable nor the quality of plywood finish shall not be less than the specified for the fairface finish.

b. Striking Period

Where the concrete compressive strength is confirmed by tests on concrete cubes stored under conditions that simulate the field conditions, formwork supporting concrete in bending may be struck when the cube strength is 10N/mm² or twice the stress to which it will be subjected, whichever is the greater, provided that such early striking will not result in unacceptable deformations due to shrinkage, creep etc..
CONCRETE FORMWORK (03100) (CONT'D)

G. Workmanship (Cont’d)

6. Striking of Formwork (Cont’d)
   b. Striking Period (Cont’d)

   In the absence of control cubes, the minimum periods before striking shall be as follows:

<table>
<thead>
<tr>
<th>Ordinary Portland Cement Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sides of columns, walls and beams</td>
</tr>
<tr>
<td>Soffits and slabs</td>
</tr>
<tr>
<td>Soffits of beams</td>
</tr>
<tr>
<td>Props to beams</td>
</tr>
<tr>
<td>Props to slabs</td>
</tr>
</tbody>
</table>

7. Trial Panels for Formwork

   When required by the Engineer the Contractor shall prepare, prior to concreting, a sample panel of size and surface texture to be agreed by the Engineer. The panel shall contain reinforcement fixed to represent the most congested part of the work. The panel shall be filled with the proposed concrete mix compacted by the method to be used in the work. As soon as practicable after compaction, the side forms shall be removed to enable the Engineer to check the surface finish and compaction achieved.

8. Spraying

   All surfaces of formwork which will be in contact with concrete, and all reinforcement, shall be damped with a fine spray of water immediately prior to concreting.
CONCRETE REINFORCEMENT (03200)

A. **Scope**

1. This section specifies reinforcement for all reinforced concrete work as indicated on the drawings.

2. Items included are quality of steel, bar cutting and bending, storage, cleaning, placement and testing.

B. **Performance and Standards**

1. All reinforcement used in the Works shall comply with the Standards listed below and this Specification.

   BS 4449: Hot rolled steel bars for the reinforcement of concrete
   BS 4466: Bending Dimensions and Scheduling of Reinforcement for Concrete
   or
   ASTM A615: Grade 40 for mild steel bars.
   ASTM A615: Grade 60 for high yield bars.

2. Alternatively, reinforcement complying with other Standards and Specification may be substituted provided that the prior written authority of the Engineer is obtained and any resulting redesign and detailing is at the Contractor's expense.

C. **Related Items**

Cast-In-Place Concrete 03300

D. **Submittals**

1. The Contractor shall furnish certificates of testing covering the chemical and physical properties of the reinforcing steel as well as the names and locations of the mills and shops supplying the materials. The properties shall be tested in accordance with BS 4449 (Hot Rolled Steel Bars for the Reinforcement of Concrete), and BS 4483 (Steel Fabric for the Reinforcement of Concrete).

2. Provide cut lengths of reinforcing as requested by the Engineer for testing.

3. Furnish the Engineer with certified mill test reports for reinforcement.
CONCRETE REINFORCEMENT (03200) (CONT'D)

D. Submittals (Cont'd)

4. Furnish the Engineer with certified materials origin complying with the properties.

5. The Contractor shall prepare shop drawings for reinforcing steel and submit to the Engineer for his approval before proceeding with steel fabrication.

E. Product Handling

1. Storage

Reinforcing bars and accessories shall be stored above the surface of the ground upon platforms, skids or other supports.

2. Identification

Labels shall be attached to all reinforcement.

F. Materials

1. Reinforcement

Hot rolled mild steel bars and hot rolled high yield bars shall comply with the requirements of BS 4449 and shall have minimum yielding strength of 2800 Kg/cm² for mild steel complying with ASTM A615 grade 40 steel, and of 4200 Kg/cm² for high yield bars type 2 deformation complying with ASTM A615 grade 60 steel. Brittle reinforcement shall not be used on site.

Mesh reinforcement shall conform to ASTM A185 or BS 4483 with a yield strength of 4200kg/cm².

Any deviation in the above strength of reinforcement shall not be accepted.

2. Bar Supports

Spacer blocks with cast in tie wire may be used with the agreement of the Engineer for support of the bottom layer of reinforcement in slab on ground, foundation, ribs and beams with surface finish, only. The blocks shall be of minimum size and made from cement, sand and small aggregate mix.

3. Tie Wire

Tie wire shall be annealed iron wire not less than No 16 gauge.
CONCRETE REINFORCEMENT (03200) (CONT’D)

G. Workmanship

1. Bar Schedule Dimensions: Cutting & Bending

Reinforcement shall be scheduled in accordance with BS 4466 and shall be cut or cut and bent to the dimensions specified on the Drawings.

Bending at temperatures below 5°C. or in excess of 100°C may only be carried out with the Engineer's approval and under his supervision.

Any reinforcement bar that has already been bent shall not be re-bent at the location of the original bend without the Engineer's permission.

All reinforcement bars shall be bent cold unless otherwise approved by the Engineer.

All bending up to 25mm shall be done using a bar bending machine.

2. Fixing

Reinforcement shall be secured against displacement especially in columns and walls. Unless specified otherwise, the actual concrete cover shall not be less than the required nominal cover minus 5mm.

In a member where the nominal cover is dimensioned to the links, spacers between the links and formwork shall be the same dimensions as the nominal cover.

Cover blocks required for ensuring that the reinforcement is correctly positioned shall be as small as possible consistent with their purpose and designed so that they will not overturn when the concrete is placed. They shall be made of concrete with 10mm maximum aggregate size and they shall be of the same strength and material source as the adjacent concrete.

Plastic chairs shall be used for all plywood fairface concrete whether in columns, walls or beams.

Reinforced chairs at 1000mm centres each direction shall be used in solid slab and 16mm bar reinforcement shall be used at 1000mm centres each direction in raft foundation.

Other types of spacers may be used only with the approval of the Engineer. Pieces of wood, metal tile or porous material shall not be used as cover blocks.
CONCRETE REINFORCEMENT (03200) (CONT'D)

G. Workmanship (Cont'd)

2. Fixing (Cont'd)

Projecting ends of ties or clips shall not encroach into the concrete cover. Tying wire shall be 1.6mm diam. soft annealed iron wire.

The position of reinforcement shall be checked before and during concreting by the Engineer and written order shall be obtained before pouring.

Beam reinforcement placed in multiple layers shall have 2.5cm bars placed as spacers at 120cm on centres.

Beams having a depth of more than 50cm shall have 12mm at 20cm on centres horizontal reinforcing bars placed on each face of the beams unless shown otherwise.

Overlap length for all reinforcing bars shall be:

a. In tension 67 bar diameters but not less than 60cm.

b. In compression 40 bar diameters but not less than 35cm.

c. In links 8 bar diameters.

Clear cover to reinforcing steel bars (including links) shall be:

a. Foundations 7.5 cm

b. Columns 4 cm

c. Walls (below ground) 4 cm

d. Walls (above ground) 2 cm

e. Beams/ribs 3.5 cm

f. Slabs 2.5 cm
G.  Workmanship (Cont'd)

3.  Surface Condition

Immediately before concrete is placed around it, reinforcement shall be clean, free from mud, oil, paint, retarders, loose rust, loose mill scale, snow, ice, grease or any other substance that they can be shown to affect adversely the steel or concrete chemically, or to reduce the bond.

4.  Spraying

All reinforcement shall be damped with a fine spray of clean water immediately prior to concreting.

5.  Testing of reinforcement

Tensile tests providing information on elastic limit, ultimate strength and stress-strain curve will be required from each delivery of reinforcement and measurements will also be required of cross section area of bars. The Contractor shall allow for three bars of each size to be tested at his own cost. When any test results do not conform to the specified standard, the reinforcement steel shall be removed from the site and the cost of subsequent testing, any remedial work and redesign shall be borne by the Contractor.
CAST-IN-PLACE CONCRETE (03300)

A. **Scope**

1. This section specifies material and workmanship for all cast-in-place concrete work as indicated on the drawings.

2. Items included are materials, mix design, production of concrete, compliance and testing, transporting, placing and compaction, curing and surface finishes.

3. Extension of contraction joints and waterstops shall be included as indicated on the drawings. Notwithstanding this, waterstops shall be used in all joints between underground wall and slab or footing connections and to all corners of water tanks.

B. **Performance and Standards**

1. All concrete and its constituent materials shall comply with the latest edition of relevant British and American Standards and this Specification. The principal Standards are listed below:

   - BS 8110: Part 1 : 1985 Code of Practice for The Structural Use of Concrete
   - BS 12: Portland Cement
   - BS 410: Test Sieves
   - BS 882:1201: Aggregate from natural sources
   - BS 3148: Tests for Water for Making Concrete
   - BS 4550: Methods of testing cement
   - BS 1881: Methods of Testing Concrete
   - BS 5328: Methods of specifying concrete, including ready - mixed concrete
   - BS 5606: Code of Practice for accuracy in building
   - ACI318-99: Concrete Works.
   - BS 5075: Concrete admixtures
   - ACI 301: Specifications for structural concrete for buildings
   - ACI 304: Recommended practice for measuring, mixing transporting and placing concrete
   - ACI 347: Recommended practice for concrete work
   - ASTM C33: Concrete Aggregates
   - ASTM C94: Ready mixed concrete
   - ASTM C143: Test method for of Portland Cement Concrete
   - ASTM C150: Portland cement
   - ACI 309: Conditions of Contract
   - ACI 315: Manual of Standard Practice for Detailing Reinforced Concrete Structures
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

C.  **Related Items**

Concrete Materials  03010  
Concrete Formwork   03100  
Concrete Reinforcement  03200

D.  **Submittals**

The Contractor is required to supply the Engineer with full details of the aggregate, water, sand, cement, admixture to be used for structural concrete. He shall also make and submit trial mixes as instructed by the Engineer.

The Contractor shall submit request for order to pour showing that all MEP reservation have already been allowed with the signature of the MEP Contracts.

E.  **Product Handling**

1.  **Cement**

   Cement shall be stored as specified herein.

2.  **Aggregate**

   Aggregate shall be stored as specified herein.

3.  **Batching and Mixing**

   Cement, aggregate, water and any admixture shall be measured and mixed as specified herein.

4.  **Ready-mixed Concrete**

   Ready-mixed concrete shall be handled as specified herein.

5.  **General**

   All materials for production of concrete shall be stored in such a way as to protect them from aggressive effects of the environment.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

E. Product Handling (Cont’d)

6. Transporting, Placing and Compacting of Concrete

Concrete shall be so transported and placed that segregation of the constituent materials does not occur. The method of transporting and or conveying concrete has to be approved by the Engineer.

The maximum free drop height of concrete shall not be greater than 1.5 metres.

Concrete shall not be placed in any part of the Works until the Engineer's approval has been given. If concreting is not started within 24 hours of approval being given, approval shall again be obtained from the Engineer. Concreting shall then proceed continuously over the area between construction joints. Fresh concrete shall not be placed against in-situ concrete that has been in position for more than 30 minutes.

No concrete shall be placed in flowing water.

All placing shall be carried out under the direct supervision of competent member of the Contractor's staff. Concreting operations shall not be permitted to displace reinforcement, or formwork or to damage the face of formwork.

All concrete shall be thoroughly compacted by vibration, during the operation of placing around reinforcement, waffles, embedded fixtures and into corners of the formwork to form a solid mass free from voids. When vibrators are used to compact the concrete, vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation of the ingredients. Care shall be taken that the vibrator is not used any closer than 75mm from the formed surface.

A minimum of three vibrators shall be permanently on site to comply with the requirements of the specifications.

Vibration of the concrete and operation shall be undertaken in such a way that the proper and complete vibrations, but avoiding over vibration, is achieved. The guidelines as given in Standard Practice for Consideration of Concrete (ACI 309) of Part 2 Concrete Practices and Inspection Pavements, of ACI Manual of Concrete Practice 1988 issued by ACI shall be followed if not otherwise directed by the Engineer.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

E. Product Handling (Cont’d)

6. Transporting, Placing and Compacting of Concrete (Cont’d)

A sufficient number of vibrators in serviceable condition shall be on Site to ensure that spare equipment is always available in the event of breakdowns.

Internal vibrators shall be capable of producing not less than 10,000 cycles per minute, and external vibrators not less than 3,000 cycles per minute.

Vibration shall not be applied by way of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided.

Concrete shall not be subjected to disturbance between 4 hours and 24 hours after compaction.

Whenever vibration has to be applied externally, the design of formwork and disposition of vibrators shall ensure efficient compaction and the avoidance of surface blemishes.

The mix shall be such that there will be no excess water on the top surface on completion of compaction.

F. Materials

1. Classification of Concrete Mixes

The class of concrete shall be as specified in (03010) Concrete Materials.

2. Constituent Materials of Structural Concrete

a. Cement

Cement shall be as manufactured in Lebanon and complying with the following requirements:

1. Alkali content for all types of cement: maximum 0.6 % equivalent of sodium oxide (Na20) (ASTM C227).

2. Sulphate Resistant Portland Cement: BS12 or ASTM C150 Type V for foundations.

3. Ordinary Portland Cement: BS12 or ASTM C150 Type I, non staining for all other members.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

F. 

Materials (Cont'd)

2. Constituent Materials of Structural Concrete (Cont'd)

b. Aggregate

(i) General

Coarse and fine aggregates shall be produced in Lebanon and comply with the following requirements:

- Unless otherwise specified or agreed by the Engineer, aggregate shall comply with the requirements of BS 882: Aggregate from natural sources or ASTM 33.

- Aggregate shall consist of fine sand or stone aggregates and crushed stone, crushed rock or gravel. Separate stockpiles of fine aggregate and each size of coarse aggregate gradation shall be used. Each aggregate type shall be from a single consistent source.

- Storage piles of aggregates shall be placed on concrete base which has good drainage. Stockpiles shall have walls separating adjacent materials and shall be covered to preclude segregation of foreign materials and to preserve the gradation. Sufficient storage shall be maintained to assure placement of concrete at the necessary rate. Use properly constructed sheds to protect aggregates from direct sun radiation and from blowing sands.

- Aggregates shall be hard, durable, clean and free from adherent coating and dust and when directed by the Engineer, shall be washed and sieved to remove deleterious substances.

- The Contractor shall supply to the Engineer for approval full details of the aggregates he proposes using prior to any concrete mix designs being approved. Such information shall at least include the source of each aggregate, current certificates of grading of the aggregate, test certificates covering sulphate, chloride and shell contents and alkaliaggregate relationship. Consequently, during the course of the Contract, further grading and test certificates shall be supplied to the Engineer at approximately monthly intervals, or at such longer intervals as the Engineer may direct. The costs of all testing shall be allowed for by the Contractor.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

F. Materials (Cont'd)

2. Constituent Materials of Structural Concrete (Cont'd)

   b. Aggregate (Cont'd)

      (i) General (Cont'd)

      Coarse and fine aggregates shall be produced in Lebanon and comply with the following requirements: (Cont'd)

      - The source of the aggregate shall not be changed without the approval of the Engineer.

      - Aggregate shall not contain any deleterious matter, such as salts, iron pyrites, coal, mice, shale or similar particles either in any form or sufficient quantity such as to adversely affect the strength and durability of the concrete.

      - All aggregates shall be screened and washed and shall have less than the following maximum salt contents as acid soluble chlorides and sulphates. The table also shows the maximum salt content allowed in the mixed concrete.

<table>
<thead>
<tr>
<th></th>
<th>Chlorides</th>
<th>Sulphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of weight of fine aggregate</td>
<td>0.06</td>
<td>0.4</td>
</tr>
<tr>
<td>Percent of weight of course aggregate</td>
<td>0.03</td>
<td>0.4</td>
</tr>
<tr>
<td>Total percent in concrete as percent by weight of cement</td>
<td>0.1 (OPC)</td>
<td>4.0</td>
</tr>
</tbody>
</table>
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

F. Materials (Cont'd)

2. Constituent Materials of Structural Concrete (Cont'd)

b. Aggregate (Cont'd)

(ii) Fine Aggregates

Fine aggregates shall be local sand and shall comply with BS 882 "Concrete Aggregates from Natural Sources" or ASTM C33 having hard and durable particles or other inert materials having similar characteristics conforming to the following requirements:

- Fineness Modules: 2.4 to 3.0 ASTM C125.

- Fineness modules shall not vary more than 0.20 from value used in establishing mix proportions. If greater deviation, the use of such aggregates shall be discontinued until suitable adjustments in mix proportions can be made and reviewed.

- Magnesium Sulfate Soundness: Max. 5% loss, ASTM C88, 5 cycles.

- Potential Reactivity: Not reactive C289.

- Content of Clay Lumps: Max. 1% by weight ASTM C142.

- Gradation requirements as follows:

<table>
<thead>
<tr>
<th>Size of Sieve Opening (Square Openings)</th>
<th>Percentage by Weight Passing-ASTM C33, C117</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 inch (9.5mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 4 (4.75mm)</td>
<td>95-100</td>
</tr>
<tr>
<td>No. 8 (2.36mm)</td>
<td>80-90</td>
</tr>
<tr>
<td>No. 16 (1.18mm)</td>
<td>60-80</td>
</tr>
<tr>
<td>No. 30 (0.60mm)</td>
<td>30-60</td>
</tr>
<tr>
<td>No. 50 (0.30mm)</td>
<td>12-30</td>
</tr>
<tr>
<td>No. 100 (0.15mm)</td>
<td>2-8</td>
</tr>
<tr>
<td>No. 200 (0.075mm)</td>
<td>0-5</td>
</tr>
</tbody>
</table>

- Fine aggregates shall be free of organic materials (ASTM C40) and other foreign matter.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

F. Materials (Cont'd)

2. Constituent Materials of Structural Concrete (Cont'd)

b. Aggregate (Cont'd)

(iii) Coarse Aggregates

Coarse aggregates for concrete shall consist of crushed gravel or crushed stone and shall meet the following requirements:

- Magnesium Sulfate Soundness: Max. 5% loss, ASTM C88, 5 cycles.
- Potential Reactivity: Not reactive C289.
- Abrasion: Max. 10% loss ASTM C131, 100 C131, 100 revolutions.
- Flat and Elongated Particles: 3:1 max. ASTM C125 5:1 max. 10%.
- Content of Clay Lumps: Max. 0.5% by weight ASTM C142.
- Shale: Max. 2% by weight.
- Bulk Saturated Surface Dry Specific Gravity: Min. 2.58 ASTM C125.

- Gradation requirements as follows:

<table>
<thead>
<tr>
<th>Size of Sieve Opening (Square Openings)</th>
<th>Percentage by Weight Passing-ASTM C33</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inch (50.0mm)</td>
<td>-</td>
</tr>
<tr>
<td>1-1/2 inch (37.5mm)</td>
<td>-</td>
</tr>
<tr>
<td>1 inch (25.4mm)</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch (19.0mm)</td>
<td>95-100</td>
</tr>
<tr>
<td>1/2 inch (12.7mm)</td>
<td>60-75</td>
</tr>
<tr>
<td>3/8 inch (9.5mm)</td>
<td>20-55</td>
</tr>
<tr>
<td>No. 4 (4.75mm)</td>
<td>0-10</td>
</tr>
<tr>
<td>No. 8 (2.36mm)</td>
<td>0-6</td>
</tr>
</tbody>
</table>

- The maximum size of aggregates shall be 3/4" (19mm) for all structural members. The maximum aggregate size shall not exceed 75 percent of the clear spacing between adjacent steel reinforcement or between reinforcement and adjacent formwork.
F. **Materials (Cont'd)**

2. **Constituent Materials of Structural Concrete (Cont'd)**

   c. **Water**

   Mixing water for concrete and water for spraying aggregates and shutters, for curing and like purposes shall be from a source approved by the Engineer. The water shall be clean, fresh, free from oil, organic matter and other deleterious substances and shall comply with the requirements of BS 5328.

   Prior to the commencement of concreting and subsequently once every month the Contractor shall sample and test the water supply for the presence of chloride salts in accordance with BS3148. The amount of dissolved solids in the water shall also be checked on a weekly basis by conductivity methods during the period during which concrete work is being carried out, and any significant change in the amount of dissolved solids recorded shall be immediately investigated by further testing for chloride salts.

   Water shall not contain more than 1000 parts per million of sulphates (SO₃) nor more than 600 parts per million of chlorides.

   If the PH value is outside 5.5 to 8.5, tests shall be carried out in accordance with BS 3148.

   The methods of sampling and testing water, to ensure compliance with the above clauses, shall be submitted to the Engineer for approval prior to the commencement of concreting.

d. **Waterstops**

   Waterstops shall be as shown on the drawings, central type four ribbed extruded shapes formed of virgin polyvinyl chloride with nailing flanges, tensile strength 134kg/cm², minimum elongation 200%. Provide performed, prefabricated junction pieces to cater for all joint intersection. (i.e. T, L fourway shapes, etc...)
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

F. Materials (Cont'd)

2. Constituent Materials of Structural Concrete (Cont'd)

f. Dry Mortar and Non-Shrink Grout

Dry mortar should be composed of 1/1 portion of cement and sand.

A minor quantity of water should be added to the mixture in order to permit placing of mortar by hand then hammered to its final position into gaps of 5cm maximum kept between columns jackets and existing slabs as indicated on the drawings.

Non shrink grout should be a packaged dry, rapid hardening cementitious material complying with ASTM C928-00.

G. Workmanship

1. Requirements for Hardened Concrete

a. Concrete Grade

For each grade of concrete the specified characteristic strength shall be as given in the relevant section.

Table 1 - Grades of Concrete:

Plain 140 kg/cm²  } (Minimum required cylinder crushing strengths at 28 days)
Reinforced 280 kg/cm²  }

b. Minimum Cement Content

The cement content shall be not less than described in the Contract.

c. Maximum Cement Content

The cement content shall not exceed 550Kg/m³ unless otherwise described in the Contract.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

G. Workmanship (Cont’d)

2. Production of Concrete

a. General

The Contractor shall provide supervision to ensure the required standard of control over materials and workmanship.

No cutting or drilling in the poured concrete or reinforcing bars shall be done unless approved by the Engineer.

During all stages of construction, slabs shall not be subjected to construction loads in excess to the imposed loads specified below:

- Stairs and Corridors: 500 kg/m²
- Parking areas: 250 kg/m²
- Commercial areas: 600 kg/m²
- Offices: 300 kg/m²
- Roof (including A/C units): 500 kg/m²

b. Cement

Cement shall be stored in dry weatherproof sheds with raised floors and each consignment shall be kept separate and distinct. Any cement that has become injuriously affected by damp or other causes shall be removed from the Site immediately.

The Contractor shall furnish, as directed by the Engineer, test certificates relating to the cement to be used in the Works. Each certificate shall indicate results of tests and analysis by an approved firm and shall state that the cement complies in all respects with the requirements of the appropriate Specification for the particular type of cement.

c. Aggregate

Single-sized coarse aggregates and fine aggregates shall be used, unless otherwise authorized by the Engineer, and stored in separate hoppers, or different stacks which shall be separate from each other. Relative proportions of coarse aggregates to be used shall be determined on the basis of the trial mixes.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

2. Production of Concrete (Cont'd)

c. Aggregate (Cont'd)

The aggregates shall be stored on a concrete slab suitably drained and bonded to prevent contamination. The aggregates shall be deposited in such a way as to prevent segregation through dropping. The aggregates shall be kept cool by shading the stockpiles from the sun, or by sprinkling them with water so that cooling results from evaporation, so that concrete can be produced within the specified temperature limits.

The overall grading of the aggregates shall be such as to produce concrete of the specified quality that will work readily into position without segregation and without the use of excessive water. The overall grading shall be controlled throughout the work so that it conforms closely to that assumed in the selection of the mix proportions. Each delivery shall be inspected and, if required by the Engineer tested in accordance with BS 812.

The Contractor shall provide copies of the results of routine control tests carried out on the aggregate.

d. Proportioning of Concrete

1. Comply with ACI Standard 211.1, OR BS 8110-85, Section 6, Para. 6.2.4. Assume full responsibility for the strength, consistency, water/cement ration, and handling of concrete. Cement, fine aggregate and the various sizes of coarse aggregate shall be measured by weight.

2. Water/Cement Ratio

Comply with BS 8110-85, Section 6, Para. 6.2.4. OR ACI 301, Chapter 3, Para. 3.8, Method 1 or 2. The water/cement ratio of a batch of concrete shall not exceed the specified maximum value by more than 5% of that value. If a maximum water/cement ratio has been determined, the ability to comply with that requirement at a suitable level of workability shall be determined by trial mixes. Maximum water/cement ratio may be judged from workability tests and approved by the Engineer.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

2. Production of Concrete (Cont'd)

d. Proportioning of Concrete (Cont'd)

3. Cement Content

Table 6.1 of BS 8110: Part 1: 1985 gives the minimum cement required when using a particular size of aggregate in a Portland cement concrete to provide acceptable durability under appropriate conditions of exposure. The reduced minimum cement contents shall only be used when trial mixes have verified that concrete with a maximum free water/cement ratio not greater than that given for a particular condition can be consistently produced and it is suitable for the conditions of placing and compacting. The Engineer shall determine the degree of exposure to be adopted for mix design.

4. Requirements for Fresh Concrete

Workability of concrete shall be such that the concrete is suitable for the conditions and placing so that after compaction it surrounds all reinforcement and completely fills the formwork.

Workability shall be assessed by means of the slump test. An acceptable value for the mean slump for each concrete mix shall be agreed with the Engineer and a value of 100mm can be taken as a guide with limits of workability of ± 25mm.

The amount of water shall be measured by weight. The batch weights of aggregates shall be adjusted to allow for a moisture content typical of the aggregate being used. All measuring equipment shall be maintained in a clean, serviceable condition. The mixer shall comply with the requirements of B.S. 1305 or B.S. 4251 where applicable. The mixing time shall be not less than that used by the manufacturer in assessing the mixer performance.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

2. Production of Concrete (Cont'd)

d. Proportioning of Concrete (Cont'd)

5. Adjustment to Mix Proportions

During production adjustments of mix proportions will be made in order to minimize the variability of strength and to approach more closely the target mean strength as approved by the Engineer. Such adjustments are regarded as part of the proper control of production by the specified limits of minimum cement content, and maximum water/cement ratio shall be maintained.

e. Batching and Mixing

The quantities of cement, fine aggregate and the various sizes of coarse aggregate shall be measured by weight unless otherwise authorized by the Engineer.

A separate weighing machine shall be provided for weighing the cement. Alternatively the cement may be measured by using a whole number of bags in each batch.

The quantity of water shall be measured. Any admixture to be added shall be measured and if solid, shall be measured by weight. Different types of cement shall not be mixed.

The batch weight of aggregate shall be adjusted to allow for a moisture content typical of the aggregate being used.

All measuring equipment shall be maintained in a clean and serviceable condition; its accuracy shall be checked over the range in use when set up at each Site, and maintained thereafter within the following limits:
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

2. Production of Concrete (Cont'd)

   e. Batching and Mixing (Cont'd)

   The accuracy of equipment shall fall within the following limits:

   Measurement of cement  Plus or minus 3% of the quantity of cement in each batch

   Measurement of water   Plus or minus 3% of the quantity of water in each batch

   Measurement of aggregate  Plus or minus 3% of the total quantity of aggregate in each batch

   Measurement of admixture  Plus or minus 5% of the quantity of admixture in each batch

   The mixer shall comply with the requirements of BS 1305 or BS 4251 where applicable. The mixing time shall be not less than that recommended by the manufacturer, subject to the Engineer's approval of the trial mixes.

   Mixers that have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed.

   f. Ready-Mixed Concrete

   Ready-mixed concrete shall comply with the general requirements of this Specification and the following special requirements. The concrete shall be carried in purpose-made agitators, operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 1 hour of the introduction of cement to the aggregate. The time of such introduction shall be recorded on the Delivery Note together with the details of each mix in case of non-compliance with the time recording the batch shall be rejected.

   Ready-mixed concrete shall be supplied by an experienced concrete producing company with proven truck record and high standards of operation to the approval of the Engineer. If the Engineer disapprove the use a producing company the Contractor shall not use his company to supply the ready mix. However approval of a company by the Engineer shall not relieve the Contractor of his responsibility to meet the specifications.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

2. Production of Concrete (Cont'd)
   f. Ready-Mixed Concrete (Cont'd)

   When truck-mixed concrete is used, water shall be added under supervision either at the Site or at the central batching plant as agreed by the Engineer, but in no circumstances shall water be added in transit. Maximum time from adding water in the mix to placing the concrete shall be 60 minutes.

   Truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 4251.

3. Surface Finish of Concrete
   a. Trial Panels

   Formwork finishes, control of colour and release agents are specified in section 03100, Concrete Formwork.

   b. Unformed Finishes

   The Contractor shall exercise careful judgment in the timing of this operation in order to obtain even exposure in accordance with the approved sample, and as described in the Contract.

   c. Protection

   Permanently exposed surfaces shall be protected from spillage, stains and damage of any sort.

4. Construction with Concrete
   a. Construction and Control Joints

      1. Comply with BS 8110, Section 6, Paragraph 6.12, OR ACI 301, Chapter 6, Paragraph 6.1 B.S. 5337.

      2. Construction joints other than those formed at movement joints shall be kept to a minimum consistent with convenience of construction and design consideration. Concreting shall be carried out continuously up to locations of construction joints.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

4. Construction with Concrete (Cont'd)

a. Construction and Control Joints (Cont'd)

3. Where it is necessary to introduce construction joints, careful consideration shall be given to their exact location. The location of construction joints shall be subject to agreement between the Engineer and the Contractor before any work commences. Construction joints shall be at right angles to the general direction of the member and shall take due account of shear and other stresses.

4. Concrete shall not be allowed to run to a feather edge and vertical joints shall be formed against a stop board. The top surface of a layer of concrete shall be level and reasonably flat unless design considerations make this undesirable. Joint lines shall be so arranged that they coincide with features of the finished work.

5. Kickers (i.e. a starter stub) carefully constructed and shall be cast monolithically with the footing.

6. Immediately prior to recommencement of concreting on a joint, the surface of the concrete against which new concrete will be cast shall be free from laitance and shall be roughened to the extent that the largest aggregate is exposed but not disturbed. Care shall be taken that the joint surface is cleaned immediately before the fresh concrete is placed against it.

7. Saturate the cleaned surface with water and slush with a coating of 1:1½ cement-sand grout. Place new concrete before grout has attained its initial set.

8. Particular care shall be taken in the placing of the new concrete close to the joint. This concrete shall be particularly well compacted and vibrated.


10. All joints shall be formed with a standard key and reinforcing bars shall be extended to provide the required lapping length but not less than 50 bar diameters.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

G. **Workmanship (Cont’d)**

4. Construction with Concrete (Cont’d)

b. **Tolerances**

Construction tolerances for concrete work shall be in accordance with ACI Standard 117-81, Part 5 and BS 5606: Code of Practice for Accuracy in Building, unless a finer tolerance required to achieve acceptable fit or appearance.

Refer to section 03310 - Concrete Tolerances

c. **Transporting, Placing and Compacting of Concrete**

See Clause E6, Product Handling.

d. **Striking of Concrete**

See section 03100, Concrete Formwork.

e. **Curing of Concrete**

The method of curing shall prevent loss of moisture from the concrete. Immediately after compaction and for 14 days thereafter concrete shall be protected against harmful effects of weather and environment including rain, rapid temperature changes, drying out and aggressive local conditions.

**Ponding with water:** Effective for flat surfaces. Curing water shall not be more than 11°C (52°F) cooler than the concrete to prevent cracking and shall be free of substances that may stain or discolour concrete.

**Curing Vertical Surfaces:** As soon as the forms are stripped off, cover the concrete surfaces with wet saturated burlap held in close contact with the concrete surfaces. Fix polyethylene sheets directly on top of the burlap and keep wet for seven (7) days after stripping. Top of columns and walls shall be continuously cured for seven days.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

4. Construction with Concrete

  e. Curing of Concrete (Cont'd)

  Slabs and flat surfaces shall be cured only by flooding. Flat concrete surfaces shall be covered immediately after concrete is placed, tamped and leveled, with burlap and polyethylene sheets on top of the burlap and flooded with water as soon as initial hardening of concrete occurs.

  Normal curing Periods: Seven (7) days is the curing period for all cast-in-place concrete under normal weather conditions (temperatures around 27°C (75°F) and normal wind speed). This period shall be extended to ten (10) days under hot weather or drying wind conditions.

  f. Hot Weather Work

  The Contractor shall ensure that the concrete constituents are sufficiently cool to prevent the concrete from stiffening in the interval between its discharge from the mixer and compaction in its final position, and shall make every effort to ensure that the temperature of the mixed concrete does not exceed 33°C at the point of deposition.

5. Trial Mixes

  No structural concrete shall be placed in the works until the relevant mix has been approved by the Engineer.

  When the Contractor designs the mix he shall, at least 35 days before the commencement of concreting, have trial mixes prepared in a laboratory to be approved by the Engineer.

  The concrete from each mix shall be tested and must satisfy the strength requirements hereabove specified.

  The Contractor shall forward full details of the designed mix to the Engineer for approval.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont'd)

5. Trial Mixes (Cont'd)

When the mix has been approved, no variations shall be made in the proportions, the original source of the cement and aggregates or in the type, size and grading zone of the latter without the consent of the Engineer who may require further tests to be made.

No approval by the Engineer of a trial mix shall relieve the Contractor of the responsibility of maintaining the works strengths required. The Engineer may also require practical tests to be made on the Site by filling trial moulds to confirm the suitability of the mix for the Works. In these tests, the type of plant used, and the formwork face to the mould shall be similar in all respects to those intended for use in the Works.

6. Records

The Contractor shall also keep a complete record of the work of concreting showing the time and date of placing the concrete in each portion of the work. The record shall be available for inspection at any time by the Engineer. Each cylinder shall be clearly marked showing from which part of the structure the concrete was obtained and the mix proportions used, and this information must be recorded on the report sheet. An accurate record is to be kept on Site of all test cubes made, identifying them to the various parts of the work, and any additives used.

7. Concrete Sampling and Testing

a. General

The cost of taking and testing of concrete samples under this Specification, including transport to a testing station where required, shall be met by the Contractor, whether the test results are satisfactory or not.

All preparation and testing of concrete samples shall be carried out in accordance with B.S. 8110 or ACI 318-95 at a testing station approved by the Engineer who shall receive certified copies of the results of all tests.

Where tests show that concrete is below specified strength, the Contractor shall remove all such concrete as directed by the Engineer. Full cost of removal of low strength concrete and its replacement with concrete of proper specified strength shall be born by the Contractor.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G. Workmanship (Cont’d)

7. Concrete Sampling and Testing (Cont’d)

b. Preliminary Tests

The Prior to the commencement of any concreting work and subsequently, whenever a change is intended, preliminary tests shall be carried out. From each of three samples of materials, a trial mix shall be made. For each class of concrete, the trial mixes shall represent at least two different water cement ratios. From each trial mix, six cylinders shall be made, three for testing at 7 days, and three for testing at 28 days. The average strength of the cylinders tested for each sample shall be taken as the preliminary cylinder strength of the mix.

The Engineer will require the preliminary test to be repeated if the difference in strength between the greatest and the least strength is more than 20 per cent of the average.

The water / cement ratio and slump adopted in the preliminary tests for each class of concrete shall be used in the works concrete. It shall be such that, if selected for use at the Site, the concrete can be worked readily into the corners and angles of the forms and around the reinforcement without permitting the materials to segregate, or free water to collect on the surface.

Preliminary tests shall have these minimum ultimate strengths given in Concrete Materials Section 03010.

c. Works Tests

During the first four days of the commencement of concreting with any particular mix, two sets of six works cylinders in each set shall be made each day. Three cylinders for each set shall be tested at 7 days, and 3 at 28 days. The above works tests shall be carried out for each class of concrete. Subsequently, the frequency of making sets of test cylinders and the number in each shall be as directed by the Engineer.

The cylinders shall be cured in the same manner and environment as the members they represent. The cylinder strength shall be accepted as complying with the specified requirement for work cylinder strength if none of the compressive strengths of the cylinders falls below the minimum strengths given in Section 03010 or if the average strength is not less than the specified minimum works cylinder strength and the difference between the greatest and least cylinder strength is not more than 20 per cent of the average.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

G. **Workmanship (Cont’d)**

7. **Concrete Sampling and Testing (Cont’d)**

   c. **Works Tests (Cont’d)**

   Alternatively, the criterion of acceptable test results shall be that not more than 5 per cent of works cylinders fall below the specified strength. For this to be fulfilled, the mean strengths of works cylinders less 1.64 times the standard deviation should not be less than the required strength. This calculation shall be made for both 7 and 28 cylinder tests as soon as 24 cylinders have been tested at each age. Thereafter, it shall be repeated as further test results become available at a frequency determined by the Engineer. The number of cylinders considered in each calculation shall be the total number of cylinders of the mix in question tested from the commencement of the Works.

   Cores shall be taken in accordance with ACI 318-95, article 5.6.4, and tested in accordance with AASHTO T24. Load testing shall be carried out in accordance with ACI 318-99, chapter 20. The Contractor shall hire an authorized independent laboratory to carry out such tests at no extra cost to the Client.

   The Engineer may make additional test cylinders to ascertain the effectiveness of the methods by which the structure is being cured, and also to determine when the structure may be placed in service. These cylinders shall be cured in the field in the same manner as the concrete placed in the structure, and the Contractor shall protect the cylinders from all damage.

   The Contractor shall take every precaution to prevent injury to the test cylinders during handling, transporting and sorting. He will be held solely responsible for any test failure caused by improper handing and transportation, or any other cause which may be detrimental to the test cylinder.

   In order that the test cylinders may be transported from filed to laboratory undamaged, the Contractor shall provide a minimum of two (2) approved boxes. [One (1) for the Contractor’s use and one (1) for the Engineer’s use]. Boxes shall be of such size to receive a minimum of six (6) test cylinders and leave space for sawdust packing around all surfaces of the cylinders. Boxes shall be approved by the Engineer. The Contractor shall, when directed by the Engineer, provide as many additional boxes as may be required by the remoteness and/or magnitude of the concrete work.
CAST-IN-PLACE CONCRETE (03300) (CONT’D)

G. **Workmanship (Cont’d)**

7. **Concrete Sampling and Testing (Cont’d)**
   
   c. **Works Tests (Cont’d)**

   When test cylinders fail to meet minimum strength requirements, the Engineer may require core samples to be taken to determine the acceptability of such structures. The Contractor shall, at his own expense, furnish all equipment required for such core samples.

8. **Tolerances**

   Comply with BS 5606 or ACI Standard 117-81, Part 5 and Concrete Preambles Section 03310, unless noted otherwise.

9. **Waterstops**

   Waterstops shall be fixed in the center of the structural member using adhesive as recommended by the waterstop manufacturer.

   Site jointing between lengths of waterstops or between lengths of waterstops and performed junction pieces shall be carried out by using a special portable jig in conjunction with a heated joints.

10. **Embedded Items**

    a. The work shall comply with ACI 304, Chapter 6, Paragraphs 6.4 and 6.5.

    b. The Contractor shall accurately set anchorage devices by line and transit, and coordinate the locating of all anchorage devices to be set for the accommodation of the work of other trades.

    c. The Contractor shall locate anchor bolts and/or threaded type inserts and bars as shown on the drawings and on shop drawings and shall obtain necessary templates from the mechanical trades as required for the proper setting of anchor bolts and other items for mechanical equipment, as required.

    d. The Contractor shall assist other trades in the installation of piping, pipe sleeves, conduit and similar items where such items are to be installed in concrete. Provide frames to securely hold anchor bolts and anchorage devices in place during construction and take care that no displacement occurs during the pouring of concrete.

    e. No electrical boxes or conduits shall be installed in bottom of slab ribs.
CAST-IN-PLACE CONCRETE (03300) (CONT'D)

G.  Workmanship (Cont'd)

11. Placing of Cyclopean Concrete (If any)

Stone and concrete shall be placed in alternate layers and in such a way that no stone shall be in contact with another or with the sides of the shuttering. All faces of cyclopean concrete shall show sound well compacted concrete.

Spells or boulders shall be clean, free from dirt or earth and shall be soaked in water prior to incorporated into the concrete.

Spells or boulders shall be free from sharp or angular edges.
CONCRETE TOLERANCES (03310)

A. Scope

This section relates to permissible deviations and tolerances for In-situ concrete work and for erection only of Precast Concrete Work.

Do not accumulate Tolerances or Permissible Deviations so that they exceed those stated for overall item. Where two or more PD’s can apply most restrictive PD governs.

Except as otherwise stated provide work within Tolerances and Permissible Deviations (PD) as follows:

1. Where a tolerance or permissible deviation is not given in this specification, recommendations or requirements of applicable BS or BSCP govern.

2. ‘Flatness’ is a measure of variability in level from average plane.

3. ‘Variation in datum’ (vid) is a measure of variability in level of average plane from its intended level. The average plane is established by averaging levels measured over a 2 to 3m grid system.

B. Permissible Deviations and Tolerances

Foundations Plain and Reinforced (including Ground Beams, Column Bases, Strips)

1. Position on plan

   PD in plan of any point measured from the nearest building grid line: ± 35mm

2. Dimensions on plan

   PD from design dimensions for mass concrete ± 50mm

   PD from design dimensions for reinforced concrete for each 300mm subject to maximum PD of ± 35mm ± 10mm
CONCRETE TOLERANCES (03310) (CONT’D)

B. Permissible Deviations and Tolerances (Cont’d)

3. Formation level (i.e. level of underside of structural concrete)

Variation in datum of surface of excavation, or upper surface of blinding concrete:

- for mass concrete ± 50mm
- for reinforced concrete ± 25mm
- Flatness for reinforced concrete ± 25mm

4. Surface level for ground beams where top surface is at, or above finished ground level:

Variation in datum of upper surface with reference to nearest transferred bench mark ± 10mm

- Flatness ± 6mm

5. Surface level for items other than above

Variation in datum of upper surface with reference to nearest transferred bench mark

- for mass concrete ± 25mm
- for reinforced concrete ± 20mm
- Flatness for reinforced concrete ± 10mm
CONCRETE TOLERANCES (03310) (CONT’D)

C. Elements or Components above Foundations
   (Except as Otherwise Stated)

1. Position on plan
   PD in plan of any point measured
   from nearest building grid line
   unless otherwise specified ± 5mm

2. Verticality
   Plumbness in height of up to and
   including 0.5m ± 3mm
   over 0.5m up to and including 1.5m ± 5mm
   over 1.5m up to and including 3.0m ± 10mm
   over 3.0m up to and including 30.0m ± 15mm
   over 30.0m ± 20mm

3. Cross Section and Linear Dimensions
   PD from dimensions of beams, slabs, columns and walls:
   Up to and including 300mm ± 5mm
   over 300mm up to and including 600mm ± 9mm
   over 600mm up to and including 1.5m ± 12mm
   over 1.5m up to and including 3.0m ± 15mm
   over 3.0m up to and including 15.0m ± 20mm
   over 15.0m up to and including 30.0m ± 25mm
   For each additional 5m or part thereof ± 5mm

4. Straightens, Bow and Camber Other Than Designed Camber
   PD of any point of surface from intended line:
   For units measuring up to and including 3m ± 5mm
   over 3m up to and including 8m ± 10mm
   over 8m up to and including 15m ± 15mm
   For each additional 8m or part thereof ± 5mm

   Variation in camber between closely associated precast units:
   for units up to 4.5m length max. 6mm
   for units over 4.5m length max. 9mm
CONCRETE TOLERANCES (03310) (CONT’D)

C.  **Elements or Components above Foundations**  
(Except as Otherwise Stated) (Cont’d)

5. Twist (distance of any one corner from the plane containing other three corners)

   For diagonal up to and including 3m  5mm  
   For diagonal over 3m up to and including 8m  10mm  
   For diagonal over 8m up to and including 15m  15mm  
   For each further 10m of diagonal or part thereof  10mm

6. Squareness of corner (longest of two adjacent sides should be taken as base line, and PD of shorter side from a perpendicular to base line is to be related to length of shorter side)

   Shorter side up to and including 0.5m  ± 5mm  
   over 0.5m up to and including 2.0m  ± 10mm  
   over 2.0m up to and including 4.0m  ± 15mm  
   4.0m and over max.  ± 20mm

   When nominal angle is other than 90°, included angle between check lines should be varied accordingly. Squareness should be measured with respect to straight lines which are most nearly parallel with features being measured.

7. Level (PD from designed level with reference to nearest TBM) of upper or lower surface

   Vid  ± 15mm  
   Flatness  ± 20mm

   Except that: For roof slabs, slabs used as finished floors and slabs to receive bonded screeds:

   Vid  ± 10mm  
   Flatness  ± 10mm

   In addition, roof slabs must be free of low spots that will not drain.

   Above is subject to overriding provisions of item quality of critical surfaces.
CONCRETE TOLERANCES (03310) (CONT’D)

C. Elements or Components above Foundations (Except as Otherwise Stated) (Cont’d)

8. Abrupt changes of a continuous in-situ surface (eg. at joints in formwork)

For concrete exposed in finished form whether painted or not: max. PD 2mm

For other surfaces including those in plant and boiler rooms, interior of lift wells, stair and landing soffits, retaining walls, location where a plywood finish or an exposed finish is required, unless otherwise stated:

max. PD 4mm

D. Overall Dimensions of a Concrete Building

1. Length and width (to be measured at lowest floor level)

   For dimension up to and including 15mm ± 15mm
   For dimensions over 15mm up to and including 30m ± 25mm
   For each subsequent 10m or part thereof ± 5mm

2. Height to structural roof level with reference to transferred bench mark

   For height up to and including 30m ± 20mm
   For each subsequent 10m ± 5mm

E. Stairs, In-Situ

1. Flight from Landing to Landing

   Position in Plan

   PD in plan of any point in relation to the nearest reference point at the same level, the distance between the two points being not more than 15m

   ± 15mm

   Length

   Length on plan of clear span (excluding landings) ± 15mm
CONCRETE TOLERANCES (03310) (CONT’D)

E. **Stairs, In-Situ (Cont’d)**

1. Flight from Landing to Landing

   **Width of Flight**

   **Height**

   Vertical height measured between either top surfaces or soffit surfaces of flight of stairs ± 15mm

   **Waist thickness**

   Thickness of waist measured at right angles to slope of flight ± 10mm

   **Difference in rise of two consecutive steps**

   4mm

   **Difference in width of tread (going) of consecutive steps**

   5mm

   **Difference in level of tread**

   With going 2mm

   Across width of stairs per 1m width measured between tread extremities 5mm

   Other widths pro rata with maximum of 5mm

   **Difference in level between tread and adjacent landing or between landing and adjacent floor are not acceptable**

F. **Door, Window and other Openings in In-Situ Walls (Excluding Lift Openings)**

1. Position in vertical or horizontal plane

   PD from designed position of centre line with reference to nearest building grid line ± 15mm

2. Width and height clear opening ± 10 - 0mm
CONCRETE TOLERANCES (03310) (CONT’D)

F. **Door, Window and other Openings in In-Situ Walls** *(Excluding Lift Openings) (Cont’d)*

3. **Plumbness of jamb**

   PD from the vertical for every 1m of height
   ± 5mm
   with a maximum of
   ± 15mm

4. **Level of sill or soffit**

<table>
<thead>
<tr>
<th>Item</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vid sill:</td>
<td>-5mm + 0mm</td>
</tr>
<tr>
<td>Soffit:</td>
<td>+5mm - 0mm</td>
</tr>
</tbody>
</table>

   Flatness: PD for every 1m of length
   ± 5mm
   maximum of
   ± 10mm

   In addition no part of sill shall be above and no part of soffit shall be below levels specified.

G. **Items Cast-In**

   Position: Unless more accurate positioning is required by other trades or operations, position of or provision for components, fixings and holes cast in, PD from its designed position of centre line of component, fixing or hole

   ± 10mm

H. **Liftwells**

   Build liftwells within permissible deviations and tolerances required by lift company, but in no case exceed those set out in BS 5655 Part 6.

J. **Concrete Cover to Reinforcement**

   Reinforcement to have a minimum of specified thickness of concrete cover as shown on drawings to every part of its surface. Except as specified or shown concrete cover to reinforcement is to be as set out in BS 8110. Negative tolerances on concrete cover are not permitted.
CONCRETE TOLERANCES (03310) (CONT’D)

K. Quality of Critical Surfaces

1. Walls and soffits where exposed or to receive paint:

   Unless specifically permitted in accordance with formwork finish specified elsewhere, PD of surface measured under a 3m long straight edge placed anywhere on surface is not to exceed 3mm. For lengths or widths smaller than 3m PD applies pro rata, with a minimum PD of 1mm.

   With exception of specifically permitted abrupt changes in surface in accordance with formwork finish specified elsewhere, variation is to be visually undetectable without use of measuring instruments under envisaged lighting conditions, and when viewed from a distance of 3 weeks.

2. Surfaces of slabs used to receive thin, liquid applied or similar materials, provide surfaces with a maximum permissible deviation of 3mm measured at any point under a 3m straight edge placed on the surface in any direction.

3. Surfaces of slabs used to receive finishes bedded in mortar or bedding materials in excess of 6mm thick, or to receive roofing or asphaltic membranes, provide surfaces with a maximum permissible deviation of 5mm measured at any point under 3m straight edge placed on the surface in any direction, except that in addition, roof slabs must be free from low spots that will not drain.

4. Surfaces of slabs which form a wearing surface, provide surface regularities as described in 2. above.

5. Comply with tolerance and quality requirements of manufacturer or applicator of other materials to be applied to surfaces.

6. The quality (ie. cleanliness, texture, smoothness and strength) is to be suitable for the end use.
BEDS AND SCREEDS (03500)

A. **Scope**

1. Screeds are to be the depths, thickness and location shown on the drawings.

B. **Performance and standards**

1. The proportion of the mixes used and the hardness of the finished beds and screeds should be determined during the course of the work by methods referred to in clause 72 B of BS CP 204. Specimens shall be provided from samples of the mixes being made and in accordance with the stipulations contained in CP 204. All screeds and beds shall be free of curling, and shall not crack unduly.

   Hollow sounding areas shall be cut out and shall be made good.

2. The tolerance of screeds and beds shall be in accordance with BS CP 204.

3. Standards

   BS CP 203, Tile Flooring and Slab Flooring.
   BS CP 204, In-Situ Floor Finishes.

C. **Related Items**

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Sealers</td>
<td>07900</td>
</tr>
<tr>
<td>Waterproofing</td>
<td>07100</td>
</tr>
</tbody>
</table>

D. **Submittals**

1. **Aggregate Samples**

   Supply samples for the Engineer's approval of all aggregates, sources of supply are to be indicated.

2. **Aggregate Testing**

   Carry out preliminary tests on natural aggregates to determine drying shrinkage as set out in BRE Digest 35, and submit results for approval. Carry out tests on aggregates to BS 812 for the following and submit for approval.
BEDS AND SCREEDS (03500) (CONT’D)

D. **Submittals (Cont’d)**

2. **Aggregate Testing (Cont’d)**
   
   a. Sieve Analysis
   
   b. Clay and Fine Silt
   
   c. Specific Gravity
   
   d. Water Absorption
   
   e. 10% Fines Value

3. **Additives**

   Additives such as workability aids shall not be used without permission of the Engineer. If such permission is sought full particulars of the material shall be submitted.

4. **Sample of Screed**

   Prepare specimens of the mixes being used for the approval of the Engineer.

5. **Other Materials**

   Submit manufacturer's data for all ancillary materials used in conjunction with the laying of beds and screeds.

E. **Product Handling**

1. **General**

   The specifications regarding the delivery, storage, handling and transport of cement and aggregates in Section 03300, Cast In Place Concrete, shall apply.

2. **Mixing**

   Except where hand-mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used. Mixers shall be thoroughly cleaned after each batch and kept free of deposit from previous batches.

3. **Transport and Placing**

   Care shall be taken to avoid contamination or segregation of ingredients in the manner in which mixed materials are transported and placed.
Beds and Screeds (03500) (Cont'd)

F. **Materials**

1. **Cement**
   
   Cement shall be ordinary Portland Cement to BS 12 or ASTM C150.

2. **Fine Aggregates**
   
   Clean washed sharp pit sand to ASTM 33 or BS 882, Part 2 Table 2, Zone 2, well graded from 5mm down.

3. **Coarse Aggregate**
   
   Clean washed crushed shingle to ASTM 33 or BS 882, Part 2, Table 1, well graded from 10mm down. Maximum drying shrinkage of concrete: 0.045%.

4. **Aggregate Quality**
   
   All aggregates shall be free from deleterious algae or minerals.

5. **Additives**
   
   Additives shall not be used without the permission of the Engineer. If permitted, such use must be maintained throughout the Contract and trowelling off must be carried out at the correct period. Calcium chloride shall not be used.

6. **Water**
   
   Water shall be clean and uncontaminated to the approval of the Engineer, and shall be tested if so instructed by the Engineer to BS 3148.

7. **Bonder**
   
   The bonder shall be a PVA based adhesive. The bonding agent shall also be incorporated in the screed mix as recommended by the manufacturer.

8. **Separating Membrane**
   
   Separating membrane shall be as shown on the drawings, and provided by an approved manufacturer.
Beds and Screeds (03500) (Cont'd)

F. Materials (Cont'd)

9. Screed Mixes

   a) For screed thicknesses up to and including 40mm 1:3 cement: fine aggregate by volume, bonded.

   b) For screed thicknesses in excess of 40mm 1:1½:3 cement: fine aggregate: coarse aggregate by volume, unbonded.

G. Workmanship

1. General

   Comply with the recommendations of BS CP 202 and BS CP 204.

2. Preparation

   Protect all existing work and approaches with sheets, duck boards or other suitable means.

   Clean all bases thoroughly to remove all dirt, dust, rust and oil.

3. Screed Preparation

   Before laying screed cut neat holes through slab where required at low points to effectively drain surplus water. When screed has drained completely, fill and seal holes to approval.

4. Pipes, Conduits Etc.

   Where any pipe, conduit, bolt head or other article is to remain buried in the screed, it shall have a strip of wire netting overlaid of sufficient width to extend 225mm each side beyond the pipe etc.

5. Unbonded Screeds

   Lay polythene sheet on the base and lap all joints not less than 50mm.
BEDS AND SCREEDS (03500) (CONT'D)

G. **Workmanship (Cont'd)**

6. **Batching and Mixing**

Mixes incorporation dense aggregate shall be batched by weight.

The water content of mixes shall be the minimum necessary to achieve full compaction, and low enough to prevent excessive mortar being brought to the surface during compaction.

7. **Laying**

The screed shall be laid so that the surface is even, smooth and free of ridges, and shall be fully compacted by approved means. Cement shall not be sprinkled on the surface.

Maintain precise levels or falls as required.

8. **Joints**

Screeds and beds shall be laid in alternate bays not exceeding 10 square metres, limiting the length of each bay to 1 1/2 times the width. The forms used shall be true and square, with steel top surface, securely fixed, and at the edges to ensure that joints are level and close butted. Wherever practicable form a joint to coincide with construction joints concrete base.

9. **Tolerances**

Sudden irregularities shall not be permitted. The maximum permissible deviation from the designed level or fall shall be plus/minus 3mm in any distance of 2m, non-accumulative.

The roof screed low spots will not be acceptable between drainage outlets.

10. **Curing and Drying Out**

Immediately after laying protect the surface from wind, draughts and strong sunlight.

As soon as the screed has set cover it closely with polythene sheeting and keep it so covered for not less than 7 days.

Do not heat screeds or the building artificially during the first 4 weeks after laying, then raise the temperature slowly.

Prevent damage by following trades.
BEDS AND SCREEDS (03500) (CONT'D)

G.  *Workmanship (Cont'd)*

11. Screeds to receive waterproofing membrane

   The Programme shall be arranged to ensure that screeds are as dry as practicable when waterproof coverings are laid.

   Screeds laid to falls shall be bonded over the full areas of the screed in all cases where the minimum screed thickness is less than 25mm.
LIGHTWEIGHT CONCRETE (03520)

A. **Scope**

Extent of work: The extent of lightweight insulating concrete work is shown on drawings and includes the provision of lightweight concrete fill.

B. **Performance and Standards**

Comply with the requirements of the following codes and standards:

- **ASTM** American Society for testing and Materials:
  - C138 Test for unit weight, yield, and Air Content of Concrete.
  - C150 Specification for Portland Cement.
  - C172 Sampling Fresh Concrete.
  - C260 Specification for Air-Entraining Admixtures for Concrete.
  - C332 Specification for Lightweight Aggregates for Insulating Concrete.
  - C495 Test for Compressive Strength of Lightweight Insulating Concrete.

C. **Related Items**

- Cast-In-Situ Concrete 03300

D. **Quality Assurance**

Material Evaluation Tests: perform material evaluation tests, for quality control and the design of concrete mixes.

Materials and installed work may require testing and retesting at any time during the progress of the work.

Allow free access to material stockpiles and facilities at all times. Tests, including the retesting of rejected materials and installed work, are to be carried out at the Contractor’s expense.
LIGHTWEIGHT CONCRETE (03520) (CONT'D)

E. **Submittals**

1. General: In addition to submittals listed below and prior to purchase, provide catalog cuts and manufacturer’s data for all items to be purchased, for review by the Engineer.
   a. Samples of materials as specified, including names, sources and descriptions as required.
   b. Laboratory test reports for concrete materials, mix design tests and quality control tests.

2. Reports: Submit written report to the Engineer for review for each material sampled and tested, prior to the start of work. Provide the project identification name and number, date of report, name of Contractor, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material and test results. Indicate whether or not material is accepted for intended use.

F. **Product Handling**

Deliver materials in manufacturer’s original undamaged packages and store off the ground and in covered sheds to protect them from damage and deterioration. Do not use cement which shows indications of moisture damage, caking, or other signs of deterioration.

G. **Job Conditions**

Do not place lightweight insulating concrete during sandstorms or rain or when ambient temperature is above 32°C or below freezing. Do not place lightweight insulating concrete except in compliance with requirements of cold weather and hog weather concreting.
LIGHTWEIGHT CONCRETE (03520) (CONT’D)

H. **Materials**

1. Portland cement : ASTM C150, Type I
2. Aggregate : ASTM C332, Group 1
3. Water : Clean, fresh, potable.
4. Air Entraining Admixtures : ASTM C260
5. Sealant : Refer to section 07900

J. **Design Mix**

1. Design lightweight insulating concrete mix to produce the following physical properties:
   a. Wet density at point of placement: 720kg/m³, plus or minus 32kg/m³, when tested in accordance with ASTM C 138.
   b. Oven dry density: 416kg/m³, plus or minus 32kg/m³, when tested in accordance with ASTM C 495.
   c. Compressive strength: minimum 0.97 Mpa, when tested in accordance with ASTM C 495.
2. Do not exceed 8 percent maximum air content.
3. Use only the minimum amount of water necessary to produce a workable mix.

K. **Workmanship**

1. **Inspection**

Contractor shall examine the areas and conditions under which lightweight insulating concrete is to placed, and correct all unsatisfactory conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
LIGHTWEIGHT CONCRETE (03520) (CONT’D)

K. Workmanship (Cont’d)

2. Preparation
   a. Expansion joints: Install expansion joints at perimeter of deck and at junctures with vertical surfaces, including curbs, walls and vents, for full depth of insulating concrete.
   b. Provide 25mm thick expansion joint material for areas with dimensions up to 30 meters in length; 40mm thick for dimensions exceeding 30 meters.

3. Installation
   a. Place lightweight insulating concrete using equipment and procedures to avoid segregation of the mix and loss of air content. Deposit and screed in a continuous operation until an entire panel or section of the roof area is completed. Do not vibrate or work the mix except for screeding or floating. Place lightweight insulating concrete to the depths and slopes as indicated on the drawings.
   b. Design curing operations immediately after placement in accordance with weather and job conditions.
   c. Following curing operation, lightweight insulating concrete shall receive a cement and sand (1:4) screed having a thickness of less than 10mm. Screed shall be well finished and trowelled smooth.

L. Field Quality Control

1. The Contractor is to take samples and conduct tests to evaluate lightweight insulating concrete.
   a. Take samples in accordance with ASTM C 172, except as modified by ASTM C495.
      i. Determine wet density in accordance with ASTM C138.
      ii. Determine compressive strength and oven dry density in accordance with ASTM C 495. Make at least 6 molds during each placement.

2. Report test results to the Engineer immediately after completion of each test.
LIGHTWEIGHT CONCRETE (03520) (CONT’D)

M. *Defective Work*

Refinish or remove and replace lightweight insulating concrete with objectionable thermal or other cracks or when physical properties do not meet specified requirements.
DIVISION 4

MASONRY

MASONRY MORTAR (04100)

A. **Scope**

1. This Section specifies the constituent materials, mixing, handling and testing of mortars for use with precast concrete blockwork and stonework.

2. Procedures for the use of mortars with precast concrete blockwork are specified in Section 04220.

3. Procedure for the use of mortar in stonework is specified in section 04400.

B. **Performance and Standards**

1. **Performance**

   The constituent materials for mortar shall be subject to the same standards of quality control as those specified for cast-in-place concrete, with regular sampling and testing. Sampling and testing of mortar mixes shall also be carried out to ensure compliance with the requirements of BS 5628.

2. **Standards**

   Cement: Portland cement complying with ASTM C150 Type I.

   Sand: Naturally occurring sand complying with BS 1198, BS 1199, BS 1200 and ASTM C33.

   Water: To comply with requirements of BS 3148.

   Colouring Agents: To comply with the requirements of BS 1014.

   Plasticisers: To comply with the requirements of BS 4887.

   Sampling and Testing of Aggregates: Carried out in accordance with BS 812, Parts 1-4.

   Storage and Testing of Mortar Samples: Carried out in accordance with BS 4551.

MASONRY MORTAR (04100) (CONT'D)

C. **Related Items**

04220 Concrete Unit Masonry  
04400 Stone

D. **Submittals**

1. **Sampling of Materials**

   As soon as practicable but at least 8 weeks before the commencement of laying, the Contractor shall arrange for representative samples of sand and cement for the approval of the Engineer. Samples shall be labeled as follows:

   a. Type of material  
   b. Name of site  
   c. Name of supplier  
   d. Source

2. **Compliance of Materials**

   The constituent materials for mortar shall be subject to the same standard or certification and compliance as those specified in Section 03300 for cast-in-place concrete.

E. **Product Handling**

1. **Storage of Cement**

   Cement shall be stored off the ground in a dry structure so as to permit inspection and used in the order of delivery. Cement affected by dampness shall not be used.

2. **Storage of Sand**

   Sand shall be stored separately, according to type, where it will not become contaminated.

3. **Reconstitution**

   Mortars shall be used before the initial set takes place. Any mortar left after this shall be discarded, and on no account shall mortars be reconstituted.
MASONRY MORTAR (04100) (CONT'D)

E. Product Handling (Cont'd)

4. Cleanliness

All plant and equipment used for mixing and transporting mortar shall be kept clean. All such containers shall be thoroughly washed out whenever mixing ceases, or whenever there is a change of mix.

F. Materials

1. Cement

The cement used in mortars shall be:

- Portland cement to BS 12 - Part 2 or to ASTM C150, type I.

2. Sand

Sand for mortar shall comply with the requirements of either BS 1198, or BS 1200 and the grading shall be to BS 1200. Sand which has been in contact with sea-water shall not be used unless the Engineer is satisfied that it has been washed adequately and that no trace of deleterious salts remains.

3. Water

Water shall be clean and free from any harmful impurity, and shall pass the tests referred to in BS 3148.

4. Calcium Chloride

Calcium chloride or additives based on calcium chloride shall not be used.

5. Colouring Agents

Pigments shall conform to the requirements of BS 1014 and shall be premixed with the cement or sand, so as not to exceed 10% by weight of the cement in the mortar, care being taken to ensure that the strength of the mortar remains adequate. Carbon black shall be limited to 3% by weight of the cement.
MASONRY MORTAR (04100) (CONT'D)

F. Materials (Cont'd)

6. Plasticisers

Plasticisers shall conform to the requirements of BS 4887, and shall be used only with the written approval of the Engineer. Only plasticisers of known chemical compositions shall be permitted. Where permitted they shall be used strictly in accordance with the manufacturer's instructions.

G. Workmanship

1. Proportioning

The proportioning of the constituents in all mortars for blockwork shall be those given BS 1200 corresponding to the appropriate mix specified by the Engineer in each respective section.

2. Mixing

Every batch of mortar shall be thoroughly mixed and shall be used within 2 hours of mixing.
CONCRETE UNIT MASONRY (04220)

A. Scope

1. This Section covers the performance standards, materials, workmanship and other requirements to be met in the construction of precast concrete hollow blocks as required for walls and partitions as shown on Architectural drawings, and to solid load bearing walls as shown on Structural drawings.

B. Performance and Standards

1. The blockwork is designed, detailed and specified to achieve a performance not less in any respect than that described in BS CP 121, Part 1: code of Practice for Walling, Brick and Block masonry, and BS 5628, Part 1 : The Structural Use of Masonry. Materials and workmanship shall comply with the above Codes of Practice and all relevant British Standards, in particular BS 6073, Parts 1 and 2. Precast Concrete Blocks, as included in his specification, and with the recommendations and instructions of the manufacturer.

2. The constituent materials for precast concrete blocks will be subject to similar standards of quality control to those specified for in-situ concrete work, with regular sampling and testing of cement, sand, coarse aggregate and water, as specified in Section 03300.

3. The blockwork shall resist a uniform force equal to 0.4 x the weight of the wall and to be laterally reinforced in vertical and horizontal directions.

4. Where indicated on plans, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E119.

C. Related Items

04100 Masonry Mortar
05010 Metal First Fixing Materials

D. Submittals

1. Sample Blocks

The Contractor shall submit for approval samples of each type of block specified. Sufficient samples shall be provided to show the range of appearance and surface quality within which the blocks shall lie.
CONCRETE UNIT MASONRY (04220) (CONT'D)

D. Submittals (Cont'd)

2. Sample Wall panels

As soon as possible upon obtaining possession of the site the Contractor shall erect samples of blockwork using the specified mortar.

Sample panels shall be not less than 2m square. Samples shall be produced until the approval of the Engineer is obtained, and the approved sample shall be retained and protected until all blockwork is completed.

3. Sample Accessories

The Contractor shall supply samples of all materials for the Engineer's approval.

4. Testing

All sampling and testing of blocks shall be carried out in accordance with BS 607, Part 1 and the frequency of testing shall be as directed at any time by the Engineer.

Certified copies of test reports shall be submitted as soon as possible after testing.

The testing of all materials used in the manufacture of the blocks shall be in accordance with the relevant British Standards and test reports shall be made available if called for by the Engineer.

E. Product Handling

1. Storage of Materials

The Contractor shall provide storage for all materials suitable for their respective kinds. Cement delivered in bags shall have a weatherproof store having a raised timber floor. (a concrete floor will not be permitted) to avoid any presetting of the material.

Storage shall be so organised to ensure a turnover of stocks on the basis of first delivered, first used. All masonry accessories shall also be stored under cover.

Sands shall be stored separately according to grade, on a prepared base that will prevent the possibility of contamination, particularly from soil.

Blocks shall be stored in stacks on a prepared base.
E. **Product Handling (Cont’d)**

2. **Maturing**

   No blocks shall be built into the structure until 21 days have elapsed from the completion of the manufacturing process allowing a longer period if possible.

   No "hot" blocks shall be delivered to site.

F. **Materials**

1. **Precast Concrete Hollow Blocks**

   The hollow blocks shall be made with an approved block making machine and the blocks and their constituent materials shall conform in all respects with ASTM C129, Part 1. The hollow blocks shall be of the following work sizes:

   - 400 x 200 x 200mm
   - 400 x 200 x 150mm
   - 400 x 200 x 100mm

   Sizes shall conform to the following, unless otherwise specified:

   a. **Length:** 400m + or -1%
   b. **Width:** as required, + or -1%
   c. **Depth:** 200mm, + or -1%.

   Hollow blocks shall be of a minimum average crushing strength of 2.8N/mm², water absorption (1% of dry weight not exceeding 20%) and the maximum drying shrinkage shall not exceed 0.06%.

   Solid load bearing blocks shall be to ASTM C90, type II - non mixture controlled, normal weight, and shall be of minimum compressive strength of 10N/mm².

   Composite walls of non-standard thickness shall be obtained by combination of different block thickness.

   Fire rating durability of precast concrete blocks shall be as follows:

   - 400 x 200 x 200mm: 2 hours
   - 400 x 200 x 150mm: 1½ hours
   - 400 x 200 x 100mm: 1 hours
F. Materials (Cont'd)

2. Cavity Walls

The blocks used for cavity shall conform to the Specification of its type as specified herein.

The construction recommendations of BS5628, part 3 should be followed in constructing cavity walls.

3. Blocks for Plastering or Rendering

Blocks which are to be plastered or rendered shall have a coarse surface, suitable in all respects to receive plaster or render.

4. Cement

Grey cement and white cement shall conform to the requirement of ASTM C150 Type I and shall be delivered to site in sealed bags.

5. Sand

Sand shall comply with the requirements of either BS 1198, BS 1199 or BS 1200 and the grading shall be to BS 1200. Sand which has been in contact with sea-water shall not be used unless the Engineer is satisfied that it has been washed adequately and that no trace of deleterious salts remains.

6. Aggregate

Aggregate shall be obtained from approved sources which shall be capable or supplying adequate guaranties of a consistent quality throughout the contract. The aggregates shall be one or more of the aggregates listed in ASTM C33, and shall conform with the British Standards listed therein appropriate to the selected aggregate.

7. Water

Water shall be clean, free from impurities and shall pass the tests referred to in BS 3148.
CONCRETE UNIT MASONRY (04220) (CONT'D)

F. **Materials (Cont'd)**

8. **Other Materials**

   The specification for other materials used in concrete blockwork construction is to be found in the Section listed below:

   Cast in Place Concrete  03300  
   Masonry Mortar        04100  
   Joint Sealers         07900  

9. **Wall Ties**

   Wall ties used for block to block or block to concrete shall be made of corrosion resistant stainless steel butterfly shaped specially made to ensure a perfectly strong key is given, and no mortar collection can take place. Cavity wall ties shall be to BS 1449 part 2, and shall be as manufactured by "Cantic" or approved equal. Size shall be:

   a. in cavities: 80mm less than the total wall thickness  
   b. in tying walls to columns: 200mm.

10. **Strip Reinforcement**

    Strip reinforcement shall be expanded galvanized steel mesh made from high tensile steel wire with straight tension strands at 19mm centers in widths to suit blockwall.

11. **Manufacture of Concrete Blocks**

    Aggregate shall be so sized, graded, proportioned and thoroughly mixed in a batch mixer with such proportions of cement and water as to produce homogeneous concrete mixture. However, in no case shall the proportion of cement in the mixture be less than five (5) standard bags (each weighing 50kgs) per cubic meter of concrete.

    Precast concrete blocks shall be manufactured in approved vibrated machines. If for any reason the strength requirement is not achieved, the cement shall be increased at the Contractor's own expense. The water used in the mix shall be clean and of a sufficient quantity to allow complete hydration of the cement without providing an excess when moulding.

    Concrete blocks shall be hard, sound, durable, sharp, rectangular shape, clean with well defined arrises free from cracks and flaws or other defects.
CONCRETE UNIT MASONRY (04220) (CONT'D)

G. Workmanship

1. Precast Concrete Blockwork

   a. Laying and Jointing: Generally

      Lay concrete masonry units with full mortar coverage mix (1:3) on horizontal and vertical face on the units.

      Construct walling with all materials fully bonded or tied together and joints filled to ensure compliance with design requirements for stability and strength. Block walls are to be full height, floor to underside of roof, unless otherwise detailed, made good around all services.

   b. Accuracy

      Blockwork, unless specified otherwise by the Engineer, shall be constructed to the tolerances given below. Notwithstanding the above, all work shall be set out carefully to ensure satisfactory junctions and joints with adjoining or built-in elements and components.

      Tolerances:

      (i) Length

      Up to and including 5m, plus or minus 10mm.

      Over 5m up to and including 10m, plus or minus 15mm.

      (ii) Height

      Up to and including 3m, plus or minus 5mm.

      Over 5m up to and including 6m, plus or minus 15mm.

      Over 6m, plus or minus 20mm.

      (iii) Straightness

      In any 5m (not cumulative), 10mm.
CONCRETE UNIT MASONRY (04220) (CONT'D)

G. **Workmanship (Cont'd)**

1. Precast Concrete Blockwork (Cont’d)
   
   b. **Accuracy (Cont'd)**
      
      (iv) Vertically
      
      In any 8 courses, plus or minus 5mm.
      
      Blockwalls shall not deviate more than 10mm from the vertical in their full height.

   c. **Height of Lifts**
      
      No portion of any section of the work shall rise more than 1.2m above the general level at any time: Between levels during construction the work shall be racked back. The maximum height of blockwork that shall be built in a day is 1.5m.

   d. **Bonding**
      
      The walls shall be built in stretching half lap bond when not specified otherwise. Setting out shall be carefully predetermined so that full length blocks occur beneath lintols.

   e. **Strip Reinforcement**
      
      Strip reinforcement mesh shall be embedded in the mortar joints between courses to form an integral structure of great tensile strength and aid resistance to stresses and vibrations.
      
      Lay the mesh reinforcement on every other course of blockwork leaving 25mm clearance from the face of the work. Spread the mortar for the next course embedding the reinforcement completely. Joints shall be overlapped 75mm minimum.

   f. **Pointing**
      
      Samples of pointing to be approved by the Engineer.

   g. **Built-in Work**
      
      Built-in items such as door jamb, louvres, access doors, lintols, steel plates shall be grouted solidly into masonry work.
CONCRETE UNIT MASONRY (04220) (CONT’D)

G. Workmanship (Cont’d)

1. Precast Concrete Blockwork (Cont’d)

   h. Interruption of the Works

      Freshly laid work shall be adequately protected at the completion of each day's work and at any interruption caused by rain or any other factor.

   j. Curing

      As laid, the work shall be kept continuously damp by sprinkling for not less than 2 days, or such other method as the Engineer may approve.

   k. Appearance

      (i) Blocks shall have unbroken arises and flat surfaces.

      (ii) Use solid blocks when cutting is required at jambs, junctions and closing of cavities ends.

      (iii) Putlog scaffolding will not be permitted.

   l. Colour

      Unless the wall is to be painted or coated, blocks of varying colour shall be evenly distributed throughout the work so that no patches appear. Different deliveries which vary in colour shall be mixed to avoid horizontal stripes and racking-back marks.

   m. Chases and Holes

      Chases and holes where permitted blockwork shall be in approved locations. They shall be cut cleanly without damage to the wall, using suitable tools, to the smallest practical size and not more than:

      (i) Horizontal and diagonal chases, 13mm depth.

      (ii) Vertical chases, 25mm depth.

      (iii) Holes, 300mm square.
CONCRETE UNIT MASONRY (04220) (CONT'D)

G. Workmanship (Cont'd)

1. Precast Concrete Blockwork (Cont’d)

n. Anchors

Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" galvanized steel sections. Anchor walls to concrete members horizontally and vertically with "L" shaped galvanized steel anchors.

Anchors shall be to the following specifications:

1. Bars to ASTM A 276, Type 316L.
2. Plate to ASTM A 167, Type 316L.
3. Fasteners to ASTM F 593, Type 316L.

Criteria for horizontal intervals of 18 x thickness of wall for external walls and 36 x thickness of wall for internal walls.

p. Cavity Walls

i. Keep cavity and ties free from mortar and debris with laths or other suitable means,

ii. Before mortar sets, clean out bottom of cavity through holes as necessary, taking care to prevent damage to dpcs.

iii. Make good holes.

iv. Bed ties not less than 50mm into each leaf, sloping towards the exterior.

v. Evenly space and stagger in alternate courses at not exceeding 1m horizontally and 400mm vertically.

vi. Provide additional ties at sides of openings, quoins and reveals, at not more than 200mm centers.
CONCRETE UNIT MASONRY (04220) (CONT'D)

G. Workmanship (Cont'd)

1. Precast Concrete Blockwork (Cont’d)

q. Shafts
   i. Build in as the work proceeds to give a smooth and even interior surface free from voids and restrictions.
   ii. Fill void between chute and surrounding work with concrete.

r. Chases and Holes
   i. Where permitted, shall be in approved locations.
   ii. Cut cleanly, without damage to the wall, using suitable tools, to the smallest practicable size and not more than:
      - Horizontal and diagonal chases: 13mm deep.
      - Vertical chases: 25mm deep.
      - Holes: 300mm square.

s. Lintels

Concrete lintels shall be provided above all openings in block walls or partitions. Lintels shall be reinforced and constructed to sizes indicated on drawings. Lintels shall be free from cracks, chips or broken edges.

Provide minimum bearing of 200mm at each jamb, unless otherwise indicated.
GLASS MASONRY UNITS (04270)

A. **Scope**

1. This Section covers the performance standards, materials, workmanship and other requirements to be met in the construction of glass masonry units as required for walls as shown on the drawings.

B. **Performance and Standards**

1. The glass block shall be designed, detailed and specified to achieve a performance approved by the Engineer and to the recommendations and instructions of the manufacturer.

2. The constituent materials for glass blocks will be subject to similar standards of quality control to those specified for precast concrete blockwork, with regular sampling.

C. **Related Items**

Masonry Mortar 04100

D. **Submittals**

1. **Sample Blocks**

   The Contractor shall submit for approval samples of each type of block specified. Sufficient samples shall be provided to show the range of appearance and surface quality within which the blocks shall lie.

2. **Testing**

   The testing of all materials used in the manufacture of the blocks shall be in accordance with the Manufacturers Standards and test reports including impact resistance, shall be made available if called for by the Engineer.
GLASS MASONRY UNITS (04270) (CONT’D)

E. **Product Handling**

1. **Storage of Materials**

   The Contractor shall provide storage for all materials suitable for their respective kinds. Cement if delivered in bags shall have a weatherproof store having a raised timber floor. (a concrete floor will not be permitted) to avoid any presetting of the material.

2. **Care of Facing Blocks**

   Blocks are to be protected from contamination such as splashes from mortar or concrete mixing etc., and stacked in a manner will ensure the retention of sharp arises and of undamaged stretcher and header faces.

   Care shall be exercised in handling, transporting and site conveyance to avoid damage.

F. **Materials**

1. **Glass Masonry Units**

   The blocks shall be 190 x 190 x 100mm impact resistant, and obtained from an approved supplier.

2. **White Cement**

   White cement shall conform to the requirement of BS and shall be delivered to site in sealed containers or bulk lorries of suitable design.

3. **Sand**

   Sand shall be obtained from approved sources which shall be capable or supplying adequate guaranties of a consistent quality throughout the contract.

4. **Water**

   Water shall be clean, free from impurities and shall pass the tests referred to in BS 3148.
GLASS MASONRY UNITS (04270) (CONT'D)

G. Workmanship

1. Laying and Jointing Generally

Construct walling with all materials fully bonded or tied together and joints filled to ensure compliance with design requirements for stability and strength glass. Block walls are to be as shown on the drawings.

Glass blocks shall be laid with horizontal and vertical joints and bedded in coloured cement mortar. The coloured cement and sand mix shall be (1:3).

Glass blocks shall be reinforced horizontally with 6mm diameter mild steel bars at every course. Reinforcement shall comply with the specifications in section 03200 and shall resist a lateral load of 900 Jules.

2. Joints and Pointing

All joints and pointing shall be struck off with the trowel as the work proceeds. All joints shall be completely filled with mortar and pointing shall be raked out to the approval of the Engineer.

3. Interruption of the Works

Freshly laid work shall be adequately protected at the completion of each day's work and at any interruption caused by rain or any other factor.

4. Curing

As laid, the work shall be kept continuously damp by sprinkling with fans or hosing, for not less than 2 days, or such other method as the Engineer may approve.

5. Appearance

The work shall be carefully set out to give a satisfactory and uniform appearance with joints consistent in width profile and perpends vertically aligned.

6. Cleanliness

Glass blocks shall be depth clean during construction and until practical completion and mortar shall not be permitted to encroach on the face when laying.
STONE (04400)

A. **Scope**

1. Provide labour, materials, equipment and services and perform operations required for installation of stone for walls and floors and related work as indicated on the drawings and specified herein.

2. Work Included: Work of this section shall include, but not be limited to, the following:
   
a. Cladding to walls, facing, copings, sills, heads, jambs.

b. Thresholds and skirtings.

c. Mortar setting beds, grouts and joint fillers,

d. Drilling, fitting and cutting of stone as required for the proper completion of the work of other trades shall be part of this section.

e. Cleaning of work prior to acceptance.

B. **Performance and Standards**

1. Materials and work shall conform to the latest edition of reference specifications and to applicable codes and standards.

2. Qualifications

   a. Fabrication of stone shall be performed by a firm which has successfully fabricated stone similar to quality specified herein, for a period of not less than five (5) years and is equipped to supply quantity shown.

   b. The Contractor shall have been engaged in the installation of stone work of this character for at least five (5) years and shall submit evidence of several satisfactory installations completed by him in the past two (2) years.

   c. Only companies having sufficient resources and a proven record of satisfactory installation of projects similar in scope and nature, will be acceptable, subject to the Engineer's approval.
B. **Performance and Standards (Cont’d)**

3. Design Requirements
   
a. Design anchors and supports under direct supervision of a professional engineer.
   
b. Design anchors to resist positive and negative wind pressures and other loads as required by applicable code.
   
c. Design anchor attachment to stone with a factor of safety of 5:1.
   
d. Design each individual anchor with a factor of safety in the vertical dead-load-bearing direction of 4:1 and in the horizontal lateral-load-bearing direction of 2:1.
   
e. Protect all accessories and materials from adverse weather conditions.

C. **Related Items**

04100 Masonry Mortar
07900 Joint Sealers

D. **Submittals**

1. Product Data: Submit copies of manufacturer's latest published literature for materials specified herein for approval, and obtain approval before materials are delivered to the site. Literature shall include:
   
a. Natural Stone.
   
b. Filler Strips.
   
c. Setting Bed and Grout Material.
   
d. Adhesive
   
e. Anchors
D. **Submittals (Cont'd)**

2. Shop Drawings: Submit shop drawings for the work of this section for approval, and obtain approval prior to fabrication of stone.

   a. Shop drawings shall indicate and show the following:

      i. Show location of work in the project, profiles and sections. show relation to adjacent work. Coordinate with related trades as required.

      ii. Indicate materials, sizes, shapes, thicknesses, including dimensions of each panel, finishes and fabrication tolerances.

      iii. Erection method and other relevant information.

      iv. Jointing clearances.

      v. Joints and connections to the work of other trades; locations of items required by work of other trade, coordinated with the work of this section.

3. **Samples**

   a. Samples of materials specified herein shall be submitted for approval, and approval obtained before materials are delivered to site.

   b. Samples of each type of stone shall consist of 300mm by 300mm pieces showing variation for each stone type specified herein. Submit enough pieces so that a good comparison can be made to establish an allowable grain, color range and finish for each stone type.

4. **Job Mockups**

   a. Prior to installation of stone, provide mock-up panels specified below with proposed range of color, finish, texture matching, jointing, accessories and workmanship to be expected in completed work. Build mockup at site, as directed, using stone and jointing, as shown and specified in accordance with final shop drawings.

   b. Provide 3m by 3m minimum sample area of stone cladding.
STONE (04400) (CONT'D)

D. Submittals (Cont'd)

4. Job Mockups (Cont'd)
   c. Make adjustments to the mockup as directed. Do not proceed until mockup stone, finish matching pattern and jointing is approved in writing. Approved mock-up shall be minimum acceptable standard.
   d. Mockup, may, with Engineer's approval, become part of the project.
   e. Mock-ups shall include all specified accessories.

5. Measurements
   a. The Contractor shall take all necessary measurements at the building as required to assure proper fabrication and installation of the work of this section.

6. Coordination
   a. All work of this section shall be closely coordinated with the work of other sections whose work affects or is affected by the work specified in this section.

E. Product Handling

1. Stone
   a. Protect stone from damage and soiling during loading, shipment, delivery and storage.
   b. Handle and store stone to prevent chipping, breakage, soiling or other damage. Do no use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials. Lift with die-belt type slings wherever possible. Do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.
E. **Product Handling (Cont'd)**

1. **Stone (Cont'd)**
   
c. Store stone on wood skids or pallets, covered with nonstaining, waterproof membrane and place at least 6 inches above the ground. Place and stack skids and stone to distribute weight evenly and to prevent breakage or cracking of stone. Protect stored stone from weather with waterproof nonstaining covers or enclosures, but allow air to circulate around stone.

d. Protect stone fixing accessories from weather, moisture and contamination with earth and other foreign material.

e. Broken, cracked, chipped, stained or damaged stone shall be subject to rejection by the Engineer whether built-in or not and replaced at the Contractor’s expense.

2. **Other Materials**

   a. Materials shall be delivered to the site in original unopened containers, clearly indicating manufacturer's name, brand name and other identifying information of foreign matter.

   b. Materials shall be stored in a dry location, off the ground and in such a manner as to prevent moisture, damage or the intrusion of foreign matter.

   c. Materials which have become damaged or otherwise unfit for use during delivery, or storage, shall be replaced at the expense of the Contractor.

3. **Project Conditions**

   a. Protect stone work from damage until final completion of the building. Remove and replace damaged work.

   b. Protect projecting members, and cover exposed flat horizontal and vertical areas and secure such covering to provide full protection, until acceptance. Remove protective coverings after acceptance.

   c. Stone work shall not be installed when ambient temperature is below 5°C or above 35°C unless temporary heat and ventilation is provided to maintain temperature during installation and for 72 hours after completion of installation.
STONE (04400) (CONT'D)

F. Materials

1. General

Stone shall be of type, colour range and finish specified below except as specified. Stone shall be sound, hard, durable, well seasoned, of uniform strength, colour and texture, free from cracks, flaws, seams, sand holes, mineral or organic impurities producing stain after weathering, free from defect impairing strength, durability or appearance, free from machine marks. Provide stone to match project samples and job mock-up as follows:

2. Natural Stone

a. Stone: shall be stone of type, colour range and finish specified in Bill Items and shown on the drawings. Stone shall be sound, hard, durable, well seasoned, of uniform strength, colour and texture, free from cracks, quarry sap, flaws, seams, sand holes, mineral or organic impurities producing stain after weathering, free from defect impairing strength, durability or appearance, free from machine marks, cut in the same direction relative to the rift as the approved samples, from one quarry; no patched stone permitted; machined and finished as specified ready for attachment and erection of stonework; work performed without the use of impact type tool or equipment or tools which produce temperatures or temperature differential damaging to the stone.

b. Provide stone to match project samples and job mock-up.

c. Stone used for decorative items such as sills, copings, cornices, etc... shall be cut to sizes and shaped as detailed on the drawings.

d. Stone shall be:

i. Yellow natural limestone shall be "Ciello Helena" antique finish, acid treated as supplied by "Mediterranean Ceramics sarl" or approved equivalent.

Natural stone shall be set with cement and sand mortar as shown on the drawings and as indicated in Bill Items.
F. **Materials (Cont’d)**

3. **Characteristics of Stone:**

The Contractor shall precise the properties of stone depending on the quarry it becomes from. However, it is recommended that the standards of ASTM, which are identical, be followed:

a) **High Density Limestone**

<table>
<thead>
<tr>
<th>ASTM Test</th>
<th>Industry Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>C97 Absorption, max. (%)</td>
<td>3.0</td>
</tr>
<tr>
<td>C97 Density, min., (lb/ft³)</td>
<td>160</td>
</tr>
<tr>
<td>C99 Modulus of Rupture, min., (psi)</td>
<td>1000</td>
</tr>
<tr>
<td>C880 Flexural Strength, min., (psi)</td>
<td>1000</td>
</tr>
<tr>
<td>C170 Compressive Strength, min., (psi)</td>
<td>8000</td>
</tr>
<tr>
<td>C241 Abrasion Index, min.</td>
<td>10-12</td>
</tr>
<tr>
<td>C67 Freeze Thaw (25 cycles)</td>
<td>NA</td>
</tr>
<tr>
<td>C217 Weathering (in)</td>
<td>NA</td>
</tr>
</tbody>
</table>

4. **Mortar Setting Materials**

a. **Portland Cement:** ASTM C150, Type I or B.S. 12 Nonstaining.

b. **Sand:** natural, clean, sand hard particles of mineral origin containing less than 0.06 percent chlorides conforming to ASTM C144. Submit sieve analysis and chloride content with certification from approved laboratory, for conformity to specifications.

c. **Water:** Potable and free of deleterious substances.

d. **Pigmented Mortar for Exposed to View Joints:** Pigments for the coloring of joints shall be high purity, chemically inert, unfading, and Alkali fast mineral oxides and specially prepared for use in mastic joint fillers. Joint colour pigments shall be used in accordance with the manufacturer's recommendations.

e. **Manufacturers** to be proposed by Tenderer as part of his Tender, in all cases to be approved by Engineer.

f. **Liquid polymer gauging liquid for bond coats.**
STONE (04400) (Cont’d)

F. Materials (Cont’d)

5. Steel Anchors and Accessories

Anchors and angles used for wet fixed stone shall be used in addition to mortar backing shall be fabricated from galvanized steel. Type and size shall be as indicated and as required to support loading involved.

Anchors, dowels, cramps, pins, inserts, nuts, bolts and washers used for mechanical fixation shall be fabricated from galvanized steel. Type and size shall be as indicated and as required to support loading involved.

All steel accessories shall be protected against adverse weather conditions.

6. Joint Fillers

Neoprene Joint Filler for non-traffic vertical or horizontal joints shall be closed cell, nitrogen blown, sponge neoprene, having a water absorption of not over 5 percent, a density of 18 to 28 pounds, and conforming to ASTM D1056, Class SC, grade SCE43.

7. Cleaner

As recommended by stone supplier.

8. Water Repellent Coating

Material shall be colourless and odourless, not flammable comprising pH 11.5 to 13 which can improve the facades' resistance to the ingress of surface water.

Material shall be "conserrado" material as manufactured by "SIKA" or approved equal.

G. Fabrication

1. a. Match approved samples of stone. Colour variation for areas shall be within limits of approved samples.

b. Examinations, selections, reviews shall be for the purpose of achieving a final appearance of stone with the greatest possible uniformity, and approval by the Engineer will be based upon the following criteria:

i. Colour within approved, preselected colour ranges and finish.

ii. Sequence matching of adjacent constituted precast panel units.
STONE (04400) (CONT'D)

G. Fabrication (Cont'd)

1. (Cont'd)
   
   iii. Graining, veining of finished work.
   iv. Conformance to approved shop drawings and details within specified dimensions and tolerances.

2. Fabrication Tolerances
   
   a. Concavity and convexity for constituted precast panel units: no greater than 1:360, maximum 3.2mm (1/8 inch) for floor units and 1.6mm (1/16 inch) for other constituted precast panel units.
   
   b. Thickness: Plus/minus 1.6mm (1/16 inch).

3. Stone shall be accurately formed to shape and dimension. Exposed faces shall be true. Beds and joints shall be dressed straight and square to face unless otherwise distinctly shown.

4. Do cutting and drilling needed for passage of materials through stone, and for other material which is to be set, built in or applied by others. Consult and cooperate with the other trades to insure that the cutting, drilling, etc. is properly done to fit and receive the other materials. Cutting shall be done by skilled mechanics.

H. Workmanship

1. Examination of Surfaces and Conditions
   
   a. All surfaces which will receive the work of this section and all conditions which affect the work of this section installation of the work of this section. Starting installation on any surface shall be construed as an acceptance of such surface and acceptance of all prevailing conditions, and as a waiver of any subsequent claim to the contrary.

2. Preparation
   
   a. Examine the Contract Drawings and Specifications in order to insure the completeness of the work required under this Section.
   
   b. Verify measurements and dimensions at job site. Coordinate and schedule work of this Section with the work of related trades to avoid delays.
STONE (04400) (CONT'D)

H. Workmanship (Cont'd)

3. Installations, generally

a. Install the work of this section in accordance with drawings, specifications, approved shop drawings industry standards and as required and directed by the Engineer.

b. Install stone and component parts by workmen especially trained and experienced in this type of work. Have a senior, qualified representative at the job to direct and supervise the various stages of operation. Representative shall be present full time during the assembly and erection of the work.

c. Installation Tolerances: Variation from Level: Do not exceed 3.2mm in 12m or more.

d. Stone showing flaws or imperfections or defects of any kind shall not be set, but shall be referred to the Engineer. The setting of any damaged or defective stone shall be entirely at the Contractor's risk.

e. Clean stone before setting by scrubbing with fiber brushes and water. Wet stone as required before setting.

f. Joints shall be located to coincide with architectural features of the adjacent walls as indicated.

g. After each piece is set it shall be wiped clean. Do not use acid cleaning.

h. Panels shall be sized as indicated on the drawings and as required to conform to job conditions. Joints shall be located to provide a symmetrical layout in each area.

j. Stone shall be set in mortar and all joints shall be filled with mortar thoroughly ridded to eliminate voids.

k. When setting stone, adjacent pieces shall be selected for similarity in colour, veining and matching.

l. Joints shall be as shown on drawings and as directed by the Engineer.

m. Apply spatter dash coat and scratch plaster coat to all walls that will receive stone cladding to act as key for stone cladding. Reinforce stone cladding by galvanized steel anchors and angles as recommended by the Manufacturer and as directed by the Engineer.
STONE (04400) (CONT'D)

H. Workmanship (Cont'd)

3. Installations, generally (Cont'd)
   n. Stone shall be set accurately, true to line, plumb and level.
   p. All exposed surfaces shall be free from waves, and faces of stone in the same plane shall be flush at joints. Arises shall be sharp and true, square and continuous with adjoining arises.
   q. Partially completed stone work shall be thoroughly covered when work is interrupted to prevent water and moisture from entering behind stone.

4. Protection
   a. All work of this section, and related adjacent construction, shall be protected from damage, staining, or other imperfections at all times. Damaged, stained, or imperfect materials shall be repaired or replaced as directed by the Engineer, to the Engineer's satisfaction, without cost to the Employer.
   b. Use all reasonable means to keep the exposed surface of stone while being laid and particularly to keep it free from and/or caulking compound.
   c. Protect all accessories and materials from adverse weather conditions.

5. Cleaning
   a. All exposed surfaces of the work of this section and related adjacent surfaces shall be maintained in a clean condition, and upon substantial completion of the Contract shall be thoroughly cleaned to the satisfaction of the Engineer.
DIVISION 5

METALS

METAL FIRST FIXING MATERIALS (05010)

A. **Scope**

1. This section specifies metals used in first fixing of all items specified elsewhere in this Specification.

2. Metals included are mild steel and galvanized steel.

B. **Performance and Standards**

1. All metals used in the Works shall comply with all relevant British Standards whether or not listed in 05010F below.

2. All metal materials shall be protected against adverse weather especially against sea deterioration effects.

C. **Related Items**

05030 Metal Finishes
05500 Metal Fabrications

D. **Submittals**

1. **Samples**

   The Contractor shall submit any samples called for by the Engineer.

E. **Product Handling**

1. All materials shall be handled, stored, transported and protected as necessary to prevent damage or deterioration.
F. **Materials**

1. **Steel**

   Mild steel sections shall conform to BS 4: Part 1, or rolled from steel to BS 4360 or ASTM A283, ASTM A 786.

   Mild steel angles shall conform to BS 4848, Part 4 or ASTM A 36.

   Square hollow sections shall conform to BS 4848, Part 2 or ASTM A 53 Schedule 40.

   Circular hollow sections shall conform to BS 1387.

2. **Cold Rolled Steel**

   Cold rolled steel sections shall generally conform to BS 2994 or ASTM A 500, Grade 5. Galvanized cold rolled steel shall be made from galvanized sheet to BS 2989.

3. **Galvanized Steel**

   Galvanized steel, not required to be galvanized after manufacture of the complete item shall be to BS 2989. Hot dip galvanized coating shall be to ASTM A 123 Table 1 or ASTM A 153 Table 1.

4. **Aluminium**

   Wrought aluminium shall be of the alloys stated and shall conform to:

   - Angle Channel, I and T Sections - BS 1161.
   - Plate Sheet and Strip - BS 1470.
   - Drawn tube - BS 1471.
   - Bars and Extruded Round Tubes and Sections - BS 1474 or ASTM B 221.
   - Alloys 6061-T6 or 6063-T6

5. **Stainless Steel**

   Bars to ASTM A 276, Type 316L.

   Plate to ASTM A 167, Type 316L.

   Fasteners to ASTM F 593, Type 316L.
METAL FIRST FIXING MATERIALS (05010) (CONT'D)

F. Materials (Cont'd)

6. Iron Casting

Gray iron casting shall conform to ASTM A48, class 30.

Malleable iron castings shall conform to ASTM A47, Grade 32510.

7. Brackets, Flanges and Anchors

Brackets, flanges and anchors shall match the supporting rails.

8. Fixings and Fastenings

Fixings and fastenings shall be of adequate size and frequency to provide the necessary stability and strength.

Unless otherwise specified fastenings are to be of the same metal as the item being fixed with matching finish or coating.

Steel bolts and nuts shall conform to BS 4190 and have 150 metric screw threads conforming to BS 3692 or ASTM A 307.

Machine screws and nuts shall conform to BS 4183 or to FS FF-S-92.

Anchor bolts shall be approved by the Engineer.

Self-tapping screws shall conform to BS 4174 or FS FF-S-92.

Wood screws shall conform to BS 1210 or FS FF-S-111 flat head carbon steel.

Drilled in expansion anchors: shall conform to FS FF-S-325, Group VIII Type I and machine bolts complying with FS-B-575 Grade 5.

Concrete inserts threaded or wedge type, galvanized ferrous castings, either malleable iron ASTM A 47 or cast steel ASTM A 27. Provide bolts, washers and shines as required, hot dip galvanized, ASTM A 153.

Drilled-in Expansion Anchors complying with FS FF-S-325 - Group VIII, Type 1, and machine bolts complying with FS-FF-B575.
METAL FIRST FIXING MATERIALS (05010) (CONT'D)

G. Workmanship

1. Quality of Work

Fabricate metalwork carefully and accurately to ensure compliance with design and performance requirements, using types and grades of metal appropriate for the purpose. Finished work must be free from distortion and cracks. Use proprietary products to manufacturer's recommendations.

2. Corners

Unless specified otherwise, miter junctions of identical sections. Miters shall be precisely formed and true in plane.

3. Holes

Holes for metric bolts and screws to be sized to BS 4186, medium fit series, unless specified otherwise.

4. Cleaning

Remove all burrs and sharp arises which would be visible after fixing or a hazard to the user.

5. Riveted Joints

Riveted joints shall be drawn tightly together, with rivets closed to completely fill holes.

6. Mechanical Joints

Mechanical joints shall be tight with no visible gaps.

Where screw heads will be visible after component is fixed, or raised screw heads would interfere with any moving part of component, use countersunk machine screws unless specified otherwise.

Mechanical Joints of components which will be located externally shall be bedded in bedding compound, including all mating surfaces, cleats and other fixings.
G. **Workmanship (Cont'd)**

7. **Welding of Steel**
   
a. Thoroughly clean surfaces to be welded.
   
   Ensure accurate fit using clamps and jigs where practicable. Use tack welds only for temporary attachment unless specified otherwise.

   Make joints with parent and filler metal fully bonded throughout with no inclusions, holes, porosity or cracks.

   Completely remove all traces of flux residue and slag.

   b. Spatter.

   Prevent weld spatter falling on surfaces of materials which will be self-finished and visible in complete work.

   c. Butt Welds.

   Butt welds which will be visible in completed work shall be finished smooth flush with adjacent surfaces.

   d. Welding of Steel.

   Metal arc welding to BS 5135, or other equal subject to approval.

   e. Do not weld, braze or solder on site without approval.

8. **Site Dimensions**

   Site dimensions must be taken before starting where necessary to ensure proper fit and relationship to other parts of the building elements.

9. **Compatibility of Materials**

   Where different metals which are incompatible are in contact, then the Contractor shall introduce a separating membrane or coating between the contact faces.

   Before fixing apply two coats of bitumen solution, or mastic impregnated tape, to surfaces of aluminium in contact with blockwall, concrete, plaster, render, or non compatible metal.
METAL FINISHES (05030)

A. Scope

1. This section covers the following types of finish to the surface of metals except where finishes are specified in other sections of the work:

   Galvanising; zinc spraying;
   Anodising.
   Powder coated finish.
   Works Priming.

B. Performance and Standards

1. All finishes shall be applied in conformity with the recognised best methods in the trade; in the case of coatings shall measure up to the specified density and/or thickness; shall where so specified afford the intended protection to the metal; shall, where required for decorative purposes, present a uniform, even and unblemished surface; and shall maintain its specified quality on all surfaces including arisses, joints, internal corners and wherever the protection or decorative effect is required.

2. All finishes shall withstand all conditions of temperature, humidity, solar radiation, sand abrasion and other conditions that can be expected at the Site, to the extent that is generally accepted as good quality and good practice.

   All finishes shall conform all current relevant British Standards with particular reference to the following:

   BS CP 3012 Cleaning and Preparation of Metal Surfaces.
   BS 729 Hot Dip Galvanised Coatings on Iron and Steel Articles.
   BS 1615 Anodic Oxidation Coatings on Aluminium.
   BS 1706 Electroplated Coatings of Cadmium and Zinc on Iron and steel.
   BS 2569 Sprayed Metal Coatings: Parts 1 and 2.
   BS 2989 Hot-dip Zinc Coated Steel Sheet and Coil.
   BS 3698 Calcium Plumbate Priming Paints.
   BS 2987 Anodic Oxide Coatings on Wrought Aluminium for External Architectural Application.
   BS 4232 Surface Finish of Blast-cleaned Steel for Painting.
   BS 4479 The Design of Metal Articles that are to be coated.
   BS 4652 Metallic Zinc-rich Priming Paint.
   BS 5493 Code of Practice for Protective Coating of Iron and Steel Against Corrosion.
   BS 6001 Sampling procedures and tables for inspection by attributes.
METAL FINISHES (05030) (CONT'D)

B. Performance and Standards (Cont'd)

2. (Cont'd)

ASTM A123  Table 1, Hot dip galvanizing.
ASTM B633  Electro-galvanizing.
ASTM A446  Hot dip galvanizing steel sheet.
ASTM A153  Table 1, Galvanizing coating on iron and steel hardware.
ASTM A383  Table 1, Galvanized coating on assembled steel products.
SSPC     Good Painting Practice.
SSPC     Systems and specifications.

C. Related Items

05010  Metal First Fixing Materials
05500  Metal Fabrications

D. Submittals

1. Samples

The Contractor shall provide the Engineer for approval with any samples called for to demonstrate the quality of the metal finishes, and shall only proceed with the generality of the work when the relevant samples have been approved.

In particular, samples shall be provided to enable selection to be made of colour and tone of aluminium works..

2. Guarantee of Anodising or Powder Coated Finish

The firm carrying out anodising or powder coated works shall be an approved specialist firm who shall furnish to the Engineer a written guarantee against failure of the finish over a ten year period subject to reasonable maintenance by the Employer as recommended by the specialist firm.

Information on processes and methods shall be submitted as detailed in G3 below.
METAL FINISHES (05030) (CONT’D)

E. **Product Handling**

1. **General**

   Prevent all damage to surfaces.

2. **Protective Film**

   Apply protection film to all exposed bright work or aluminium works. The film shall be applied prior to site delivery and completion of the Contract without leaving adhesive remnants on the protected item.

   The requirements in respect of handling and temporary protection set out in Appendix G of BS 3987 relating to aluminium works shall be strictly complied with.

F. **Materials**

1. **Galvanised Steel Sheet**

   Galvanised steel sheet, not required to be galvanised after manufacture of the completed item, shall be to BS 2989.

2. **Galvanised Works**

   Unless otherwise described, work specified to be galvanised shall be galvanised after manufacture or fabrication by immersion in a zinc bath in one operation in accordance with BS 729, to produce a coating not less than 200 micron.

3. **Anodising of Aluminium**

   a. All anodic coating and sealing of aluminium members shall conform to the requirements of BS 3987 and BS 1615.

   b. The work shall be carried out by a firm approved by the Engineer.

   c. Anodising shall be by the 'hard' integral process. The Kalcolor, Analok or Duranodic processes, applied in each case to the appropriate aluminium alloy, will be acceptable. The Contractor shall be responsible to ensure that the correct alloy is used and that the anodising firm and the manufacturer of the articles to be anodised are mutually satisfied on this point. The Engineer shall be informed of the selected process.
METAL FINISHES (05030) (CONT'D)

F. Materials (Cont'd)

3. Anodising of Aluminium (Cont'd)
   
   d. The thickness of the anodic coat shall be an average of 25 microns, and not less than 21 microns.
   
   e. The colour and surface texture of each category of anodised items shall be selected by the Engineer by reference to approved samples.

   The texture of all anodised surfaces shall be mechanically produced, non-directional etched, and shall be satin unless otherwise specified.

   f. The anodising of any part or component shall be carried out as far as is feasible after that part or component has been fully formed and fabricated.

4. Powder Coated Finish of Aluminium

   The procedure of powder coated shall be as follows:

   a. After decreasing and cleaning the profiles shall undergo a chemical conversion treatment.
   
   b. The thermo-hardinery polyester powder coated shall be applied under an electrostatic pulverisation field.
   
   c. Then the complete polymerisation of the polyester powder shall be obtained by heating in an over to a temperature of ± 190°C.
   
   d. The coating thickness shall be 60 microns.

5. Works Priming of Steel

   Primer for steel, shall apply, and is to be painted on site shall be calcium plumbate primer to BS 3698.
G. **Workmanship**

1. **General**

   All finishes shall be properly applied to give a surface free from distortion or cracks, and shall be subject to strict quality control.

   Making good of damaged finishes shall only be done with the agreement of the Engineer and by approved methods.

   Where making good is not agreed, the damaged component shall be removed and replaced.

2. **Preparation**

   All metals shall be carefully and thoroughly prepared for the finish that is to be applied including cleaning and removal of dirt and loose particles by hand, power driven carborundum discs, wire brushes (where steel is being prepared wire brushes must have steel bristles) etc. All welding slag, weld spatter, anti-spatter compounds, paint, grease, flux, rust, burns and sharp arisses shall be removed. All defects which would show after application of the finish shall be made good.

3. **Anodising**

   The anodising shall present a uniform appearance of all visible surfaces in a colour and texture corresponding to the approved sample for the item concerned, and within the range of tolerance for colour and texture demonstrated by the approved tolerance samples. The extent of 'significant' surfaces, as defined in BS 1615, shall be agreed between the manufacturer and the anodised, and approved by the Engineer, as shall the position and size of contact marks. All necessary pre-anodic treatments to achieve the required textural finish shall be carried out. The film of anodising shall be free of inter metallic particles, resistant against pitting and bloom, and free from banding or streaking.

   The sampling procedures applied to general production for acceptance of the product by the Engineer shall be agreed with the Engineer and shall be in accordance with guidance given in BS 6001.
METAL FINISHES (05030) (CONT'D)

G. Workmanship (Cont'd)

4. Powder Coating

The powder coating shall present a uniform appearance of all visible surfaces in colour and texture corresponding to the approved sample for the item concerned. Within the range of tolerance for colour and texture demonstrated by the approved tolerance samples.

5. Works Priming

See sections 09900 for full Painting Specification. Entirely coat the whole of the fabricated steelwork, prior to assembly, including all contact surfaces, with specified primer, applied to prepared surfaces which shall be clean and dry.
METAL FABRICATIONS (05500)

A. **Scope**

This section covers metal fabrications but not limited to the following:

- Galvanized steel balustrades and handrails
- Stainless steel miscellaneous elements and features
- Ventilation grilles
- Gutter gratings
- Access traps and covers
- Ramp anchor strips
- Aluminium cabinets for fire hose
- Metal paneling
- Steel bridges
- Galvanized steel and stainless steel ladders
- Miscellaneous steel

B. **Performance and Standards**

1. All handrails and balustrades shall be designed to withstand an intensity of load on the top rail of 740N/m.

2. All work shall be as approved by the Engineer.

BS CP 3 chapter V, Part 1 and BS 6180.

C. **Related Items**

05010  Metal First Fixing Materials  
05030  Metal Finishes  
07800  Canopy  
08110  Steel Doors  
08210  Wood Doors  
09900  Painting  
10350  Flag Poles

D. **Submittals**

1. **Samples**

The Contractor shall supply such samples as the Engineer may require, fully finished except where the finish is to be site applied.
METAL FABRICATIONS (05500) (CONT'D)

D. **Submittals (Cont'd)**

2. **Shop Drawings**

   The Contractor shall provide at his own expense all layout and detailed drawings as required by the Engineer. The responsibility and the procedure for submission of drawings shall be as set out in section 01300, Submittals.

   Where Site dimensions have been taken prior to the submission of the drawings, Site dimensions which vary from design dimensions shall be given on the drawings and they shall be clearly identified as such.

3. **Manufacturer's Data**

   With shop drawings, submit two copies of manufacturers' specifications, anchor details and installation instructions for products to be used in fabricating metalwork.

4. **Certificates**

   Anodizing: obtain certification from anodizer that the specification grade has been applied and submit a copy to the Engineer.

E. **Product Handling**

1. **Protection and Handling Generally**

   Prevent distortion of metalwork during transit, handling, storage and fixing.

   Store under cover.

   Protect finishes.

   Prevent damage to arises, projecting features, and surfaces which will be exposed in the finished work.

   Prevent contact with mud, ashes, plaster and cement.

   Provide protective coverings as necessary and remove all protection on completion.

   Do not use railings as strutting or supports after fixing.
METAL FABRICATIONS (05500) (CONT'D)

F. **Job Conditions**

1. **Co-ordination**
   
   a. Liaise with the Engineer, Sub-Contractors and others as necessary to help ensure co-ordination of the work with related building elements and services.
   
   b. Provide anchorage devices and fasteners, temporary braces and anchors, as required for building into concrete and masonry, and any necessary templates and instructions.

G. **Materials**

1. All materials shall be as set out in section 05010, Metal First Fixing Materials.

2. All fabrications shall accord with the Engineer's detail drawings or with shop drawings when these have been approved by the Engineer.

H. **Workmanship**

1. **Quality of Work**

   Fabricate metalwork carefully and accurately to ensure compliance with design and performance requirements, using types and grades of metal appropriate for the purpose. Finished work must be free from distortion and cracks. Use proprietary products to manufacturer's recommendations.

2. **Pre-Finished Metal**

   Pre-finished metal may be used if:
   
   a. Finish complies with this Specification.
   
   b. Methods of fabrication do not damage or alter appearance of finish.
   
   c. Finish is adequately protected during fabrication.
H. Workmanship (Cont’d)

3. Corners

Unless specified otherwise, mitre junctions of identical sections. Mitres shall be precisely formed and true in plane.

4. Holes

Holes for metric bolts and screws to be sized, medium fit series, unless specified otherwise.

5. Moving Parts

When assembled all moving parts must move freely and without binding.

6. Cleaning

Remove all burrs and sharp arises which would be visible after fixing or a hazard to the user.

7. Bonding

Prepare surfaces of metals to receive adhesives by degreasing and abrading mechanically or chemically.

Use adhesives to manufacturer's recommendations.

Form bond under pressure.

8. Riveted Joints

Riveted joints shall be drawn tightly together, with rivets closed to completely fill holes.

9. Mechanical Joints

Mechanical joints shall be tight with no visible gaps.

Where screw heads will be visible after component is fixed, or raised screw heads would interfere with any moving part of component, use countersunk machine screws unless specified otherwise.

Mechanical Joints of components which will be located externally shall be bedded in bedding compound, including all mating surfaces, cleats and other fixings.
H. Workmanship (Cont'd)

10. Welding of Steel

a. Thoroughly clean surfaces to be welded.

Ensure accurate fit using clamps and jigs where practicable. Use tack welds only for temporary attachment unless specified otherwise.

Make joints with parent and filler metal fully bonded throughout with no inclusions, holes, porosity or cracks.

Completely remove all traces of flux residue and slag.

b. Spatter.

Prevent weld spatter falling on surfaces of materials which will be self-finished and visible in complete work.

c. Butt Welds.

Butt welds which will be visible in completed work shall be finished smooth flush with adjacent surfaces.

d. Welding of Steel.

Metal arc welding subject to approval.

e. Welding of Stainless Steel.

TIG welding or other methods subject to approval. Use double level butt welds, backing bars to remove heat, jigging, tack welds and any other measures necessary to minimize distortion. Remove slight distortion by light hammering, taking care not to damage surface finish.

f. Welding of Aluminium Alloys.

TIG welding or MIG welding or gas welding or other methods subject to approval.

g. Do not weld, braze or solder on site without approval.
METAL FABRICATIONS (05500) (CONT'D)

H. Workmanship (Cont'd)

11. Site Examination

Site dimensions must be taken before starting where necessary to ensure proper fit and relationship to other parts of the building elements.

Examine existing fabrications to which new work is to be attached and the areas and conditions where metal fabrication work will be done. Do not proceed before correcting unsatisfactory conditions.

12. Compatibility of Materials

Where different metals which are incompatible are in contact, then the Contractor shall introduce a separating membrane or coating between the contact faces.

Before fixing apply two coats of bitumen solution, or mastic impregnated tape, to surfaces of aluminium in contact with brickwork, concrete, plaster, render, or non compatible metal.

13. Fixing

a. Position metalwork accurately, plumb, level and true to line. Fix securely to prevent pulling away, deflection, or prevent other movement during use. Do not distort when tightening fastenings.

b. Remodel existing and erect new metal fabrication in accordance with details and approved shop drawings to properly match with existing metal fabrication and other construction. Conceal connections wherever possible, or use unobtrusive connections.
METAL FABRICATIONS (05500) (CONT’D)

G. Workmanship (Cont’d)

14. Balustrades and Handrails

a. Fabricate balustrades and handrails in steel to comply with requirements indicated for design, dimensions, details, finish and member sizes, including wall thickness of pipe, post spacings and anchorage, but not less than required to support structural loads.

b. Details, composition, dimensions and fixing balustrades and handrails shall be as detailed on drawings and as indicated in Bill Items.

c. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections and attachment of balustrades and handrails to other work. Furnish inserts and other anchorage devices for connecting balustrades and handrails to concrete or masonry work.

d. For balustrade posts set in concrete, fabricate sleeves less than 150mm long and with steel plate closure welded to bottom of sleeve.

e. Steel balustrades and handrails shall receive rust inhibitive coating, prime coat and finishing coats as indicated on drawings. Galvanized steel intended for painting shall be etched properly to receive coating.

15. Ladders

a. Fabricate galvanized steel and stainless steel ladders with dimensions, spacings, details and anchorages as indicated on drawings and as described in Bill Items.

b. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

c. Support each ladder at top and bottom and at intermediate points spaced not more than 1350mm centres by means of welded or bolted steel brackets.

d. Brackets as detailed to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 120mm.
METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

15. Ladders (cont’d)

  e. Extend side rails above top rung and return rail to wall structure where shown on details.

  f. Ladders inside basement water tanks shall be made of stainless steel pipes and rungs, properly attached to walls. No fixed ladders are required outside all water tanks.

  g. Prepare, prime and apply one coat undercoat and two finishing coats of semi-gloss oil paint to other ladders.

  h. Galvanized steel intended for painting shall be etched properly to receive coating.

16. Access Traps

  a. Fabricate steel access trap for transformer room to dimensions shown on the drawings and indicated in Bill Items.

  b. Access traps shall comprise thick steel sheets, angle frames and associated ironmongery all to the standards set by EDL.

  c. Provide all necessary fixing accessories and anchorages.

  d. Prepare and apply coating to access traps as recommended by EDL.

  e. Galvanized steel intended for painting shall be etched properly to receive coating.

17. Access Covers

  a. Fabricate steel access covers for sump pit to dimensions and details indicated on the drawings and bill items.

  b. Access covers shall comprise 3mm thick steel checker plate sheets, 50 x 50 x 5mm thick angle frames and associated ironmongery. Frame shall be screwed or welded to surrounds with dovetail anchors at four corners of each cover.

  c. Provide all necessary fixing accessories and anchorages.

  d. Prepare, prime and apply one coat undercoat and two finishing coats of semi-gloss oil paint.
G. **Workmanship (Cont'd)**

18. **Ventilation Grilles**

   a. Fabricate ventilation steel grilles for transformer room to dimensions and details indicated on the drawings and Bill Items.

   b. Grills shall comprise steel bars, plates, angles, frames and accessories, fixing accessories all to the standards set by EDL.

   c. Provide all necessary flashings, sealant, fixing accessories and anchorages.

   d. Prepare and apply coating to ventilation grille as recommended by EDL.

   e. Galvanized steel intended for painting shall be etched properly to receive coating.

19. **Stainless Steel Miscellaneous Elements and Features**

   a. Fabricate stainless steel elements and features to comply with requirements indicated for design, dimensions, details and sizes as shown on the drawings and as indicated in Bill Items.

   b. Stainless steel shall be type 316L to ASTM standards indicated in section 05010.

   c. Provide brackets and anchors for interconnections and attached to walls and structural support members.

   d. Provide sleeves and necessary fixing accessories.

   e. Submit shop drawings to Engineer for approval before fabrication.

Items covered under this section shall include but not limited to:

- Tubular supports at planter pits.
- Upstand covers.
- Skirtings
- Counters
- Feature strips.
METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

20. Boiler and Hood Flue Heads

a. Furnish and install galvanized steel flue heads with sufficient thickness for 800mm pipe heads. The pipe shall be fixed to structure with ties and plates as indicated. Flue heads shall have perforations as indicated on drawings.

b. Fabricate items to dimensions and details shown on drawings and indicated in Bill Items.

c. Provide all necessary fixing accessories and anchorage.

d. Coordinate with electro-mechanical installations. Special detailing shall be done where the pipe enters the service rooms.

e. Prepare, prime and apply black epoxy coating.

f. Hangers and supports shall be galvanized steel made to the purpose as per the manufacturer's instructions.

g. Refer to drawing details for installation which shall be the minimum requirements for the materials and workmanship.

21. Steel Wire Mesh Openings

a. Fabricate steel mesh louvers to dimensions and details indicated on the drawings and Bill Items.

b. Mesh shall comprise 2mm diameter mesh steel with 20 x 20mm void and minimum 50 x 50 x 5mm thick galvanized steel angle frames.

c. Provide all necessary flashings, sealant, fixing accessories and anchorages.

d. Prepare and apply two coats of undercoat and two finishing coats of semi-gloss oil base paint.
METAL FABRICATIONS (05500) (CONT’D)

G. Workmanship (Cont’d)

22. Gutter Gratings
   a. Provide steel gutter grating comprising 45 x 8mm steel plates at 60mm centers set in 50 x 50 x 5mm angle frame to suit trench drain where indicated.
   b. Install grating and frames true to lines and levels. Ensure that grating is well installed and is nonrocking. Frame shall be anchored as indicated.
   c. Frames shall be anchored to surrounds with dovetail anchors at least 200mm long every 1 meter from each side.
   d. Prior to grating installation, contractor shall inspect supports for correct size, layout, alignment and verify that surfaces to receive grating are free of debris. Contractor shall report to Consultant in writing any defects considered detrimental to proper application of grating so defects can be remedied before grating is applied.
   e. Install grating according to manufacturer's recommendations and shop drawings.
   f. Grating frame shall be coated with two (2) coats of coal tar epoxy having a total dry film thickness of not less than 0.50mm.

23. Ramp Anti-Slip Strips
   a. Fabricate ramp anchor strips from 50 x 50 x 5mm thick galvanized steel angles and set in concrete to full width of ramp at 500mm centers as detailed on drawings.
   b. Provide all necessary fixing accessories and anchorage.
   c. Prepare, prime and apply epoxy coating.
METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

24. Metal Panelling
   a. Furnish and install 3mm thick sheet metal panels similar to elevator doors material in all respects.
   b. Fabricate to dimensions and details shown on drawings.
   c. Provide fixing accessories and anchorage to support the paneling and align with elevator doors.
   d. Coordinate work with conveying systems requirements and coordinate with elevator supplier.
   e. Apply coating to steel panels of same material, colour and finish of elevator doors.

25. Aluminium Cabinet for Fire Hose
   a. Fabricate aluminium cabinet for fire hose to dimensions shown on drawings and as indicated in Bill Items.
   b. Requirements and materials and workmanship shall be as stated in section 08120.

26. Steel Bridges
   a. Work shall be of the design, gauge, dimensions appropriate for purpose and shall be installed in location indicated on the drawings, and specified herein. Work and finishes shall be first class in every particular and in accordance with trade practice. Insofar as practicable, fabrication, assembly and fitting of the work shall be executed in the shop with the various parts or assemblies ready for erection at the building. Work that cannot be shop assembled shall be given a trial fit at the shop to insure a proper and expeditious field assembly.
   b. Shop assemblies shall be in the largest possible sections in order to reduce field connections to a minimum.
METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

26. Steel Bridges (Cont'd)

c. Removable members shall be carefully machined and fitted and shall be secured by screws or bolts of proper size and approved spacing. Structural supports, hangers and built-in reinforcement wholly concealed within the finished assemblies shall be as indicated or required.

d. Construct bridge members to conform to sizes and arrangements indicated. Join pieces together by welding unless otherwise indicated. Provide complete bridge assemblies, including metal framing, hangers, supports, railings, balusters, struts, clips, brackets, bearing plates and other components necessary for the support of bridge and platforms, and as required to anchor and contain the bridge on the supporting structure.

e. Steel members shall receive rust inhibitive coating, prime coat and finishing coats of fire retardant paint.

27. Miscellaneous Steel and Structural Steel

a. Furnish and install steel framing, posts, bracing, brackets, columns, beams, girders, plates, angles, channels, closures, brackets and miscellaneous steel indicated on the drawings or described in this specification.

b. Miscellaneous steel shall include required support steel for the work of this section, and for the work of other sections.

c. Steel members shall be of such shapes and sizes indicated on the drawings and details or as required to suit the condition and shall be provided with necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and other connecting and adjoining work.
METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

27. Miscellaneous Steel and Structural Steel (Cont'd)

d. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Space anchors 300mm on center and provide minimum anchor units of 31.6mm by 6.4mm by 200mm steel straps.

e. Steel shall be of domestic source conforming to ASTM A36 or equivalent.

f. Included under this heading of miscellaneous steel are:

i) Steel angles for framed opening in floors.
ii) Steel angles and plates for pipe and duct protection.
iii) Elevator tie down and machine beams.
iv) Rails, plates, strips and angles as shown on the drawings.
v) Galvanized steel angles to support precast slabs.
DIVISION 6

WOOD AND PLASTICS

ROUGH CARPENTRY (06100)

A. Scope

1. The work covers sub-frame, rough framings, blocking and grounds, etc., whether shown on drawings or as commonly necessary in the proper execution of the work of the Contract.

B. Performance and Standards

1. All members shall be employed, secured, jointed as in most appropriate, and constructed so as to transmit the loads and resist the stresses to which they will be subjected.

2. All materials shall conform to the appropriate British Standards where such standards exist, including:
   
   
   BS 1186, Quality of Timber and Workmanship in Joinery.
   
   BS 4471, Part 1: Sizes of Sawn and Planed Timber.
   
   BS 1455, Plywood: Note, Grade 3 acceptable for rough carpentry.

C. Related Items

06300 Wood Treatment
06400 Architectural Woodwork

D. Submittals

1. Samples

   If the Contractor wishes to use a timber outside the range of timbers specified he shall obtain the Engineer's approval of the proposed timber.

2. Drawings

   Where appropriate, shop drawings shall be submitted for approval.
ROUGH CARPENTRY (06100) (CONT'D)

E. Product Handling

1. General

All timber shall be handled, stored and protected as specified in section 06400.

F. Materials

1. Seasoning and Treatment

All timber used in rough carpentry, whatever its use, shall be properly seasoned and treated with preservative as specified in section 06300, Wood Treatment.

2. General

The timber shall in every case be appropriate to its use, free from pitch pockets, splits, loose, decayed or dead knots, knot holes, knots exceeding half the width of the face on which they occur, rot, beetle attach, and warping detrimental to its specified use.

3. Softwood

Softwood shall be Douglas Fir, European Redwood, Longleaf pine or other equal approved.

4. Nails

Nails shall comply with BS 1207, Part 1, of a type to suit each case.

5. Screws

Steel screws shall be finished to resist corrosion.

G. Workmanship

1. General

All rough carpentry shall be soundly constructed and firmly fixed and shall be properly sized, to perform its intended function, all to the complete satisfaction of the Engineer.

All work shall be full to the dimensions stated, whether wrought or unwrought.
WOOD TREATMENT (06300)

A. **Scope**

1. This section covers the preservative treatment of timber against fungal decay and wood-destroying insects and the seasoning of timber.

B. **Performance and Standards**

1. Preservative treatments shall comply fully with the requirements of BS 5268, Part 5: Preservative Treatments for Constructional Timber, BS 1232: Guide to be Choice, use and Application of Wood Preservatives.

2. All treatments shall also accord with the recommendations and requirements of the relevant British Wood Preserving Association's Standards and Specifications.

3. Seasoning shall be in accordance with the recommendations of BS CP 112.

C. **Related Items**

06100 Rough Carpentry
06400 Architectural Woodwork
08210 Wood Doors

D. **Submittals**

1. **Preservative Treatment**

   a) The Contractor shall obtain the Engineer's approval to the company he wishes to employ for the preservative treatment and to the method of treatment that will be used.

   b) A certificate of assurance that treatment has been carried out shall be attached to all timber deliveries and copies shall be passed to the Engineer in respect of all timber used in the work. The certificate shall state the nature of the preservatives used and the method of application, and shall certify compliance with the relevant British Standards and the Standards of the British Wood Preserving Association.

   c) **Engineer's Access to Preservative Treatment Works**

      The Contractor shall arrange for visits by the Engineer or his representative to the preservative treatment works if so required.
WOOD TREATMENT (06300) (CONT'D)

D. Submittals (Cont'd)

1. Preservative Treatment (Cont'd)
   d) Sample

   If required by the Engineer the Contractor shall submit samples of treated timber over-painted with the specified finishing paints or other coverings.

2. Seasoning
   a) The Contractor shall provide certificates of moisture content in respect of all timbers after they have been kiln-dried.
   b) The Contractor shall supply the Engineer with a moisture meter for the purpose of determining the moisture content of timber on Site, whether or not incorporated in the work.
   c) If so required by the Engineer samples of timber shall be taken as directed from site and sent in sealed containers to the Timber Research for Development Association for testing for moisture content.

E. Product Handling

1. Safety Precautions

   Care shall be taken in the handling of all preservatives in respect of their toxicity and also their flammability. Where applicable the precautions listed in Overseas Building Notes No. 170, Appendix 3 shall be taken. The requirements of the Health and Safety at Work Act shall not be contravened.

2. Stacking After Treatment

   After preservative treatment timber shall be stacked so as to allow free air circulation to all surfaces.

3. Transport and Delivery

   After treatment all handling in transport, delivery, storage etc., shall be as specified in section 06400 F.
WOOD TREATMENT (06300) (CONT'D)

F. **Materials**

1. The exact nature of the chemicals to be used and the method of treatment shall be determined by the firm carrying out the treatment to meet the following conditions:
   
   a) The treatment shall give full protection to the timber.
   
   b) The classification of hazard shall be 'Medium hazard' in respect of fungal attack and insect attack in general.
   
   c) The firm applying the treatment shall be fully aware of all relevant conditions and hazards which pertain to the Site.
   
   d) The preservative shall be organic solvent-borne.

2. **Method**

   Treatment shall be by Vacuum Pressure Impregnation System.

G. **Workmanship**

1. **Timbers to be Treated**

   All timbers shall be treated with preservatives except heart wood.
   
   All plywood, chipboard and other wood-based board materials shall be treated.

2. **Preservative Treatments: Standards**

   The treatments shall be carried out in accordance with BS 5268 Part 5, BS 1282 and British Wood Preserving Association's Standards and Specifications.

3. **Preservative Treatments: General**

   a) The timber to be treated shall be free from mud, dirt and inner or outer bark, and free also from paint, polish or other surface finish.
   
   The timber shall be free from all signs of attack by wood-destroying fungi or insects.
WOOD TREATMENT (06300) (CONT'D)

G. Workmanship

3. Preservative Treatments: General (Cont'd)

b) Moisture Content Before Treatment

The Contractor is to ensure that the timber to be treated is of the correct moisture content recommended by the firm applying the treatment.

c) Fabrication Before Treatment

All possible sawing, planing, cross-cutting boring, drilling or other wood working shall be carried out before impregnation treatment.

d) Work after Treatment

If any surface is exposed after treatment by boring, cross-cutting, forming joints, or any other work, that surface shall be given two liberal brush coats or spray application of any approved preservative. Similar treatment shall be given to any damaged surface.

e) All workmanship shall be quality-controlled and in accordance with the appropriate instructions of the firm carrying out the treatment.

5. Seasoning of Timber

All timber shall be seasoned in accordance with the recommendations of BS CP 112 to suit the uses to which it will be applied, taking into account the following conditions:

Normal climatic conditions:

Summer  20-35 Deg. C  RH 50
Winter   0-20 Deg. C  RH 25
ARCHITECTURAL WOODWORK (06400)

A. **Scope**

1. The extend of Architectural Woodwork is detailed and shown on the drawings and schedules and covers but not limited to:
   - Wood paneling to walls

2. All work shall be shop fabricated where feasible and where shop fabrication will result in better workmanship than can be achieved on Site.

B. **Performance and Standards**

1. The Design, Materials and Workmanship of all woodwork shall comply with the provisions of BS 1186, Parts 1 and 2: Quality of Timber and Workmanship in Joinery. Where better quality is required this will be noted subsequently in this Specification.

2. **Hardwoods**

   BS 1186, exposed surface Class 1 in Appendix C. (clauses 8,9,10,11,15,16 shall read 'not permitted').

3. **Plywoods**

   BS 3444, bonding type BR, long grain.

4. **Hardboard**

   BS 1142, section 2.

5. **Adhesives**

   BS 1204, Part 1 Gap filling, Part 2 close contact bonding WBP.

C. **Related Items**

   06100 Rough Carpentry
   06300 Wood Treatment
   09570 Wood Flooring
D. **Submittals**

1. **Samples of Timber**

   The Contractor shall provide for the Engineer's approval samples of each species of timber used, in accordance with the Specification.

   Each sample shall be labeled to indicate its species and the purpose for which it will be used, and country of origin. Where the indicated use is for a component which is specified as requiring a wood treatment, the sample shall be treated and the labeling shall indicate the treatment.

   Where the indicated use is for a component which is to be stained, clear sealed, polished or otherwise finished so that the grain and character of the timber is apparent, two samples shall be provided, one unfinished and one finished.

   Each sample shall be a piece 1.5m long; its cross-sectional profile shall accord with its intended use or, where the species will have a variety of uses, shall be not less than 75 x 35mm in section. Approved samples shall be regarded as representative of the quality and characteristics of the timber that shall be used in the work.

2. **Other Board and Sheet Samples**

   Samples, 1m square and with one half finished as may be specified, shall be provided for approval of each type of hardboard, plywood, blockboard, chipboard or other board or sheet material specified, or which the Contractor wishes to use appropriately labeled as in D1 above.

3. **Drawings**

   Before fabrication is commenced shop drawings are to be submitted to the Engineer for approval. The drawings shall be fully dimensioned and shall indicate those dimensions which have been ascertained by Site Measurement. They shall be specific as regards indication of materials and compliance with Standards and Specification clauses as appropriate. Methods of fixing and relationship to adjacent components shall be as shown as necessary.

4. **Certificates**

   The Contractor shall supply certificates of assurance that all specified preservative and treatments have been carried out.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

E. Product Handling

1. Handling Generally

All materials and components shall be carefully handled at all times at Works, during transportation and storage and on Site to prevent damage. Any damaged or defective item shall be removed from Site and replaced at no additional cost.

2. Protection

Joinery shall be stored in the manufacturer's factory stores before delivery and shall be given waterproof cover during transit and at all times kept dry. Timber and wood-base sheet materials shall be stored in stacks with provision for air circulation within stacks. The bottom of stacks shall be protected against contact with damp surfaces.

All necessary precautions are to be taken to protect timber products from fungus or insect attack before, during and after incorporation in the work. Joinery shall be protected from damage with approved temporary covering.

3. Delivery to Site

No joinery shall be delivered to work Site until conditions are suitable.

F. Materials

1. Softwood

Softwood shall conform to BS 1186, Part 1, Class 2. Exposed surfaces shall be as defined in Appendix C. Softwood shall be kiln dried, free from Sapwood, pitch pockets, and Wayne edge.

It shall be free of splits, ring shakes, knots exceeding 25mm diameter or exceeding half the width of the face on which they occur, loose or decayed or dead notes or knot holes unless cut out and plugged.

The softwood shall be of low resin content. The species of timber shall not be mixed unless so specified in any group of items.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

F. Materials (Cont'd)

2. Hardwood

Hardwood shall be Mahogany or Canadian red cedar and shall conform to BS 1186, Part 1, with exposed surface conforming to Class 1 as defined in Appendix C, subject to the proviso that clause numbers 8,9,10,11,15 and 16 shall read 'not permitted'. The material shall be kiln dried, free from Wayne edge, warping, brittle heart, rot stain (in so far as this will affect the finished appearance only) and beetle attack. Isolated sound tight knots will be permitted provided they do not occur on joints or on visible surfaces.

3. Plywood

Plywood generally shall comply with the requirements of BS 1455, bonding type WBP, Grade 1 face veneer having the grain of the face parallel to the long dimension of the board. The thickness shall be as indicated on the drawings and in no case shall be less than 5mm. Manufacture shall be by the dry-cementing process.

Where plywood is specified on the drawings as 'Resin Bonded' it shall be similar in all respects to a material complying with BS 1088, Plywood for Marine Craft.

4. Blockboard and Laminboard

Blockboard and laminboard shall be to BS 3444, bonding type BR, Grade 1 face veneer, having the grain of the face parallel to the long dimension of the board. The face veneer shall be approved by the Engineer. The thickness of the board shall be as shown on the drawings.

Where the edges of the board are exposed in the work they shall be lipped in hardwood matching the face veneer and shall show 9mm thickness on the board face.

5. Chipboard

Chipboard shall be resin bonded, having a density of not less than 480 Kg/m³, and shall comply with the requirements of BS 5669. Thickness shall be as shown on the drawings.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

F. **Materials (Cont'd)**

6. **Hardboard**

The various type and qualities of fibre boards shall comply in all relevant respects with BS 1142, fibre building boards, for insulating board, standard hardboard and medium hardboard in accordance with section 2 that standard.

7. **Adhesives**

   a. **General**

      Synthetic adhesives for general joinery use shall comply with BS 1204, part 1, gap filling: Part 2 close contact bonding WBA: cold setting with in a range of 10° -25° C, warm setting 25° -90° C. The Contractor shall select the type of adhesive appropriate to the form of jointing to be adopted and to the working temperature to be expected.

   b. **Plywood, Blockboard, Laminboard:** adhesives shall comply with BS 1203, WBP Grade.

   c. **Plastic laminates etc.,** adhesives shall be of urea formaldehyde type from an approved manufacturer.

   d. Any other applied sheet material will be fixed with adhesive to the manufacturer's instructions.

8. **Nails**

All nails and pins shall comply with BS 1202, Part 1 of a type to suit each case. Nails in external work shall be galvanized.

9. **Screws**

All steel screws shall be finished to resist corrosion by sherardizing, cadmium plating, nickel plating or other approved finish.

Screws shall be protected steel, stainless steel, brass silicone bronze, nickel/copper alloy or aluminium as specified on drawings or as appropriate to the work. Screws for fixing hardware shall match the items being fixed.

Screw heads shall be for the generality of the work, countersunk slotted. Screw heads in the finished work shall, unless otherwise described, be brass, bronzed finish with matching fully countersunk brass cups. Phillips cross-head screws or pozidrive screws shall be used where so described on drawings.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

F. Materials (Cont'd)

10. **Bolts**

   Bolts shall be steel and comply with BS 916 and washers to BS 3410, Part 2.

11. **Wood Paneling**

   a. Mahogany panels 20mm thick fixed to walls with softwood battens.

   b. Provide all necessary fixing accessories and anchorage.

   c. Panels shall be preserved and finished as indicated or as otherwise directed by the Engineer.

   d. Adjacent panels shall be selected for similarity in veining and matching.

   e. Coordinate wood paneling with wood flooring in the same area.

G. Workmanship

1. **General**

   Sizes, thicknesses and methods of fixing shown on the drawings and stated in the Bills of Quantities shall be fully adhered by the Contractor.

2. **Quality**

   The Contractor shall be responsible for the proper rigid and sound construction of all components and joints including the selection of jointing methods to provide the largest possible gluing area, and the use of suitable and sufficient fixing to all connections.

   All joinery shall be substantially fixed to a high standard of accuracy and to Engineer's satisfaction.

3. **Site Dimensions**

   The Contractor shall take all necessary Site dimensions to ensure an accurate fit of all items.

4. **Building Tolerances**

   The Contractor shall take note of the agreed tolerances for the structural element of the buildings.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

G. Workmanship (Cont'd)

5. Sizes

Timber sections shown on detail drawings are full finished sizes. The Contractor must allow for sawn sizes that will achieve the dimensions required after planing and machining. Grounds, backings, fixing slips etc. may be sawn sections of the size indicated.

6. Preservative Treatment

No converting to smaller sections, planing, rebating etc. will be permitted after treatment, and cutting to length shall be avoided as far as possible. Cut ends, bored holes etc. made after treatment shall have the cut generously swabbed with an approved preservative.

7. Framing and Jointing

The terms 'frame', 'framed' or 'framing' means work put together by proper carpentry or joinery joints such as morticing and tenoning, dovetailing, doweling etc. Butted and screwed or nailed joints or halved and the like will not be accepted for framed work, unless specifically so shown on the drawings.

All joints shall be properly made and accurately machined to give a perfect fit without gaps between shoulders of the joints and abutting surfaces. All joints shall be glued properly under pressure with the best quality glues of the appropriate type, applied in accordance with the glue manufacturer's instructions.

Open joints disguised with filler will not be accepted. Excess glue shall be cleaned off.

Glue staining of surfaces that are to receive a clear finish will not be accepted.

8. Timber Finishing

On completion of assembly and gluing-up the surface of all members shall be cleaned off to ensure a true surface, and shall be sanded to ensure that a planner marks, grain texture or joints are apparent after decoration.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

G. Workmanship (Cont'd)

9. Arises

All exposed arises shall be finished rounded to a radius of 1.5mm.

10. Matching

Joinery for staining, clear sealing or polishing shall have all surfaces of the same character of grain and similar colour.

11. Fixing Generally

The Contractor shall fix all joinery items securely and accurately: fixings shall not be visible on exposed surfaces of finished components beyond the extent shown on the drawings. The fixed components shall be plumb and square. The Contractor shall supply all necessary nuts, bolts, screws, rawlbolts, grout, lugs, packings, grounds etc. required to fabricate components and complete the installation.

12. Grounds

Grounds shall be clean sawn hardwood or softwood, free from knots, splayed as required, plugged to walls as necessary to ensure complete firmness, and in continuous lengths, level, even and plumb.

Grounds shall be treated with a preservative as specified in F2 above.

13. Drilling and Plugging

Where fixing to concrete or blockwork etc., (except where plugs are shown on drawings) holes for screws shall be drilled with a rotary drill and plugged with cold caulking compound or approved proprietary plugs. No end grain fixing into timber plugs will be allowed. Where fixing to hollow partitions etc. the method of fixing (by toggle bolt, butterfly bolt, expanding bolt etc.) shall be agreed by the Engineer.

Fixings shall be at such intervals as will provide firm fixing to the approval of the Engineer.
ARCHITECTURAL WOODWORK (06400) (CONT'D)

G. Workmanship (Cont'd)

14. Screwing and Nailing

Screw heads in work which is to be painted are to be sunk below the timber surface and stopped. Screws which are visible only on the opening of cabinet or cupboard doors or in other locations as may be approved by the Engineer shall be brass countersunk. Screws fixing panels etc., which may be periodically removed for access purposes shall be brass countersunk with fully countersunk brass cups. Small items such as beads or fillets shall be fixed with brass cups and screws.

Screws in exposed hardwood surfaces generally or any timber which will be stained or clear finished, shall be sunk and pelted with timber of matching species and with the grain of the pellet in the same direction as the grain of the member.

Where nails are permitted they shall be of lost-head type, punched in and stopped with approve hard stopping.

15. Notching

Notching and drilling of joinery members for services, conduits, etc. shall be kept to a minimum and the responsibility for any weakening of members cause thereby shall be the Contractor's.

16. Final Finishing

Ensure after fixing that all work is cleanly finished and ready to receive Site-applied finishes.

17. Timing of Site Work

Joinery work in general shall not be installed until the building is enclosed, watertight and dry to the satisfaction of the Engineer.

18. Defective Work

Should any shrinkage, warping or other defects appear during construction or during the defects liability period, all such defective work shall be made good at the Contractor's expense.
DIVISION 7

THERMAL AND MOISTURE PROTECTION

WATERPROOFING (07100)

A. **Scope**

1. **General**

   This section specifies the provision and installation of the complete waterproofing system for the works as detailed on the drawings and as indicated in the Bills of Quantities.

2. **Qualification**

   The waterproofing systems including protection and all associated accessories and works shall be executed by a specialist firm(s) having at least 4 years experience in installation of materials described herewith. The specialist(s) shall provide evidence of successful completion of similar works for the approval of the Engineer before commencing any work.

   The manufacturer's qualified representative shall visit the job site immediately prior to commencement of works and as and when required and directed by the Engineer to satisfy the Engineer and to instruct the specialist(s) in the correct methods of execution of the works.

B. **Performance and Standards**

1. All work shall be provided and carried out in such a way that there shall be undivided responsibility for all component parts and for the whole system as an entity. The membrane shall be covered by 10 years warranty.

2. The system shall not permit water or moisture penetration through any component part of the waterproof layer in any condition of weather that may be encountered.

3. All materials, mineral or organic, shall be resistant to decay over the life expectancy of the whole waterproofing system.

4. The completed waterproofing system and its constituent components must not suffer breakdown or degradation of performance under temperature changes in a range between -10°C and +40°C nor under conditions of thermal shock.
WATERPROOFING (07100) (CONT'D)

B. Performance and Standards (Cont'd)

5. Provisions shall be made for accommodating any movement of the structural deck and adjacent building materials and components, moisture movement, creep and shrinkage movements and thermal movement in the -10°C to +50°C range.

6. All materials shall be of a standard not less than that set out in the current editions of all relevant British and/or American Standards.

C. Related Items

- 03300 Cast-In-Place Concrete
- 03500 Beds and Screeds
- 07200 Thermal Insulation
- 07600 Flashing and Sheet Metal
- 07900 Joints Sealers

D. Submittals

1. Prior to commencing work, the Sub-contractor shall obtain from the membrane manufacturer full fixing instructions which shall be handed to the Engineer.

2. The Sub-contractor shall submit shop drawings at large scale for approval of the Engineer prior to commencing work.

3. The Sub-contractor shall carry out a sample area after approval of shop drawings, minimum 10m² including jointing between sheets, perimeter skirtings and flashings, and work to the pipe penetration, together with samples of internal and external angles.

4. Before commencing the work, the Sub-contractor shall submit written statement signed by him stating that the Sub-contract documents for the waterproofing have been reviewed with a qualified representative of the waterproofing materials manufacturer and that he is in agreement that the selected materials for waterproofing are proper, compatible and adequate for the application shown.
D. **Submittals (Cont'd)**

5. **Guarantee**

The Sub-contractor shall submit to the Engineer a guarantee stating that all works have been carried out in accordance with the drawings and specifications and shall be guaranteed free from defects in material and workmanship and shall be leakproof for a period of ten (10) years from the date of issuance of the completion certificate. The Sub-contractor shall agree to repair (including any replacement of materials) any leaks resulting from defective materials or workmanship during the guarantee period at no additional cost to the Employer.

The Sub-contractor shall also pass on to the Employer any and all guarantees provided by the sub-contractor and manufacturers of individual members of the system.

E. **Product Handling**

1. **Handling Generally**

All sheet and slab materials shall be carefully handled at all times, during transportations, storage and on Site to prevent damage. Particular care shall be taken to prevent damage to the edges of sheet and slab material.

All materials shall be maintained in a condition which shall in no way cause deterioration of the material.

Any damaged or defective items shall be removed from Site and replaced at no additional cost.

2. All products shall be delivered clearly marked and stamped with the manufacturer's name, brand name, installation instructions and identification of various items.

F. **Materials**

1. **Screeding**

Screeds thickness shall be as shown on the drawings and shall be cement and sand laid to slope as specified in section 03500.
WATERPROOFING (07100) (CONT'D)

F. Materials (Cont'd)

2. Flat Roofs, Top Roofs and Terraces

The waterproofing system shall be a cold applied emulsion coat applied to the dry clean screed at an average of 350gr/m² with hot applied elastomeric membrane 4mm thick composed of SBS (styrene-butadiene-styrene) modified bitumen reinforced with non-woven polyester 180gr/m² and covered with thermal insulation boards then protected with polypropylene separation sheet and gravel layer as detailed on the drawings.

The Membrane shall be protruded to upstands and parapets and fastened with flashings. Apply ultra-violet protective coating to all exposed surfaces of the membrane especially that protruded to upstands and parapets.

Loosely laid cement tiles shall be placed over the gravel layer in indicated locations to form passage for roof machinery only.

3. Outdoor Terraces (Finished by Landscape Architect)

The waterproofing system shall be a cold applied emulsion coat to the dry clean screed at an average of 350gr/m² with hot applied elastomeric membrane 4mm thick composed of SBS (styrene-butadiene-styrene) modified bitumen reinforced with non-woven polyester 180gr/m² and protected with polypropylene separation sheet then covered with floor tiles as detailed on the drawings.

The Membrane shall be protruded to upstands and parapets and fastened with flashings as detailed on the drawings.

4. Gardens and planters

The waterproofing system shall be sloped screed to bottoms and smooth finished plaster to walls covered with cold applied emulsion at an average of 350gr/m² with hot applied elastomeric membrane 4mm thick anti-root composed of SBS (styrene-butadiene-styrene) modified bitumen reinforced with non-woven polyester 180gr/m² with fiberglass anti-root reinforcement self protected with polypropylene separation sheet then covered with gravel layer, then covered with a geotextile garden filter layer, then vegetal soil.
WATERPROOFING (07100) (CONT’D)

F. **Materials (Cont’d)**

5. **Underground Retaining Walls**

The waterproofing system shall be PVC sheeting suitably formulated from a homopolymer vinyl chloride resin in accordance with ASTM Specification D1755 and durability to ASTM D3083. The sheeting shall be capable of being sealed to itself using heat-sealing, HF welding, and solvent welding techniques applied to the dry clean concrete surface or plastered surfaces positive and negative applications covered with non-woven polypropylene felt which shall be 10% polypropylene resistant to all natural occurring soil alkalis and soil acids and shall not be affected by bacteria and fungi and then covered with protection board. The system shall extend 150mm to walls above ground levels and fastened with flashings as detailed on the drawings.

6. **Raft Foundations**

The waterproofing system shall be PVC sheeting as specified for underground retaining walls, laid over the blinding bed and then protected with screed bed before pouring the foundations.

7. **Slab on Grades**

The waterproofing system shall be vapour barrier laid on well compacted sub-base before casting the slab on grade as detailed on the drawings.

8. **Wet Areas**

The waterproofing system shall be a low viscosity bitumen compound waterproofing materials, cold approved with special connections to pipe penetration to BS 3416-1975 and ASTM C309.

9. **SBS Membrane Characteristics**

a. **Performance**

   Tensile strength : 700 N/5 cm  
   Elongation : 45 %  
   Resistance to point loading : 25 kg  
   Tear resistance : 25 daN
WATERPROOFING (07100) (CONT'D)

F. Materials (Cont'd)

9. SBS Membrane Characteristics (Cont'd)
   
   b. Composition

   Non-woven polyester : 0.180 kg/m²
   Elastomeric bitumen   : 4.600 kg/m²
   Plastic film          : 0.020 kg/m²

   c. Elastomer SBS bitumen

   Elongation            : 1500%
   Penetration at 25º C  : 40
   Softening point       : 130º C
   Cold flexibility      : -20º C
   Strain at break       : 70 N/cm²

   d. Approved materials

   "Superseal" - Bitumat co ltd
   "Nordflex M" by Nord Bitumi; SPA, Verona, Italy.
   "XYPEX" CDR-C-48-73, United Kingdom
   "Paraflex ARD/s" by Imper, Italy.
   "TELCOFIBRA" - composan construccion - Spain
   "Force MB40 PY 180 GR" by Axter, France.
   "AXTER" - force 400 line- France
   Biagioli spa - geotextile sheet 150gr/m²
   or approved equal.

10. PVC Membrane

<table>
<thead>
<tr>
<th>PVC Minimum Material Properties ANSI/NSF 54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Style</td>
</tr>
<tr>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Minimum Thickness</td>
</tr>
<tr>
<td>D 1593</td>
</tr>
<tr>
<td>57mil</td>
</tr>
<tr>
<td>1.45mm</td>
</tr>
<tr>
<td>Density</td>
</tr>
<tr>
<td>D 792</td>
</tr>
<tr>
<td>1.20</td>
</tr>
<tr>
<td>Tensile Strength</td>
</tr>
<tr>
<td>D 882</td>
</tr>
<tr>
<td>138lbs</td>
</tr>
<tr>
<td>614N</td>
</tr>
<tr>
<td>Elongation</td>
</tr>
<tr>
<td>D 882</td>
</tr>
<tr>
<td>450%</td>
</tr>
<tr>
<td>Tear Resistance</td>
</tr>
<tr>
<td>D 1004</td>
</tr>
<tr>
<td>Die C</td>
</tr>
<tr>
<td>14lbs</td>
</tr>
<tr>
<td>62N</td>
</tr>
<tr>
<td>Low Temperature Impact</td>
</tr>
<tr>
<td>D 1790</td>
</tr>
<tr>
<td>-20F</td>
</tr>
<tr>
<td>-29C</td>
</tr>
<tr>
<td>Dimensional Stability</td>
</tr>
<tr>
<td>D 1204</td>
</tr>
<tr>
<td>Max. Cng.</td>
</tr>
<tr>
<td>5%</td>
</tr>
<tr>
<td>Hydrostatic Resistance</td>
</tr>
<tr>
<td>D 751</td>
</tr>
<tr>
<td>Method A</td>
</tr>
<tr>
<td>150 psi</td>
</tr>
<tr>
<td>1030 kPa</td>
</tr>
</tbody>
</table>
WATERPROOFING (07100) (CONT'D)

F. **Materials (Cont'd)**

11. **Non Woven Polypropylene Felt**

<table>
<thead>
<tr>
<th>Mechanical Properties</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide width strip tensile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BS6906: Part 1, ASTM D4595</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean peak strength MD</td>
<td>kN/m</td>
<td>17.90</td>
</tr>
<tr>
<td>Elongation at break MD</td>
<td>%</td>
<td>17.20</td>
</tr>
<tr>
<td>CBR puncture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BS8906: Part 4 - ASTM D4832</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean peak strength MD</td>
<td>N</td>
<td>954-740</td>
</tr>
<tr>
<td>Grab tensile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM D4832</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean peak strength MD</td>
<td>N</td>
<td>1225-915</td>
</tr>
<tr>
<td>Elongation</td>
<td>%</td>
<td>104-104</td>
</tr>
<tr>
<td>Trapezoidal tear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM D4533</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean peak strength MD</td>
<td>N</td>
<td>498-400</td>
</tr>
</tbody>
</table>

| Hydraulic Properties           |              |              |
| Permeability                   |              |              |
| BS6906: Part 3 - ASTM D4491-89 |              |              |
| Flow rate                      | cm/sec       | 0.35-0.43    |

| Physical Properties            |              |              |
| Mass per unit area             | g/m²         | 500-300      |
| Thickness 2kpa                 | mm           | 4.34-3.34    |

12. **Geotextile Sheet Characteristics**

Non-woven polypropylene fibres protective sheet against static or dynamic puncture.

<table>
<thead>
<tr>
<th>Draining and antipunching sheet for waterproofing membranes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Nominal thickness</td>
</tr>
<tr>
<td>Tensile strength (longitudinal/trans.)</td>
</tr>
<tr>
<td>Maximum elongation (longitudinal/trans.)</td>
</tr>
<tr>
<td>Tear strength (KN)</td>
</tr>
<tr>
<td>Resistance to punching (KN)</td>
</tr>
<tr>
<td>Permittivity (1/s)</td>
</tr>
<tr>
<td>Filtration diameter (uM)</td>
</tr>
<tr>
<td>Longitudinal capillarity (M/S)</td>
</tr>
<tr>
<td>Cross capillarity (M/S)</td>
</tr>
</tbody>
</table>
WATERPROOFING (07100) (CONT’D)

F. Materials (Cont’d)

13. Separation and Protection Layer
   0.3mm polyethylene sheet according to ASTM D1755-92.

14. Primer
   Primer for bonding to screed shall be from the approved manufacturer.

15. Mastic Pointing
   The turn-in of the membrane into the groove in the concrete shall be pointed
   with mastic as specified in Section 07900.

16. Gravel and Pebbles
   Gravel and pebbles shall be rounded with no sharp edges on roofs and in
   planters as detailed on the drawings, size 16-32mm all fine aggregates
   screened off.

17. Protection Board
   Protection Board shall be 3.2mm thick semi-rigid and composed of an
   asphaltic mineral fortified core formed between two asphalt coated
   fibreglass liners which are weather coated and sealed under heat and
   pressure during the process of manufacture. The protection board shall be
   applied to form continuous protective layer over the membrane
   waterproofing. All edges should be butted lightly and all intersecting
   surfaces cut to fit.

18. Bituminous Coating
   Solvent type bituminous mastic, normally free of sulfur, compounded for
   375 micrometers (15 mil) dry film thickness per coat according to BS3416.

19. Vapour Barrier
   Shall be 6 mil polythene sheet and in accordance with ASTM-E96.

20. Insulation
   Insulation shall be extruded polystyrene board as specified in section 07200.

21. Flashings
   Flashings shall be 3mm thick continuous aluminium pressure plates with
   non-corrosive fasteners to BS 1470 designation N53 Temper grade 0 or
   ASTM b209.
WATERPROOFING (07100) (CONT’D)

G. Workmanship

1. Conditions of Screed and Surrounding Walls

Before laying the membrane, ensure that the screeds are to the correct falls, and that any preliminary preparation work including the formation of grooves is complete. The screed must be clean and dry and wood float finished, free from ridges, protuberances and hollows. Surrounding walls shall be smooth finished.

2. Protection

Prevent damage to the system during installation and after. Lay paving slabs, shingle etc., immediately after the laying of the membrane. On no account shall materials be mixed or stored on the roofing membrane, nor shall it be use as a building platform.

3. General

The whole of the roofing, flashings and formed fittings and waterproofing shall be carried out completely in accordance with the manufacturer's instructions.

The membrane and primer shall be laid and fixed as directed by the manufacturer of the system.

Lap joints shall be minimum 150mm wide.

The membrane shall be laid in the direction flow of the water.

4. Waterproofing System

The membrane and primer shall be laid and fixed as directed by the manufacturer of the system.

Lap joints shall be minimum 150mm wide.

The membrane shall be laid in the direction flow of the water.
WATERPROOFING (07100) (CONT'D)

G. Workmanship (Cont'd)

5. Waterproofing System for Basement Walls and Under Raft Foundation

The first layer 500kg/m² of the non woven polypropylene felt shall be laid on concrete blinding. The surface of the non woven polypropylene felt layer shall be cleaned prior to laying the PVC sheeting. A second layer 300kg/m² of non woven polypropylene felt shall be laid on the PVC sheeting. Then, 0.3mm PE sheet shall be laid on top before concreting. When placing the PVC sheeting, sufficient thermal slack shall be incorporated to ensure that harmful stresses do not occur in service. The slack wrinkles shall be distributed evenly.

All field seams of PVC membrane shall be tightly bonded using dual seam hot wedge welding techniques. Qualification welds shall be prepared at the beginning of each seaming period, and at least every four hours. Heat welded seam qualification welds will be qualitatively tested for field seam Peel Adhesion (ANSI/ NSF-54, Annex A, Part 5).

Shop and field seams shall conform to the strength requirements as listed in the tables below:

<table>
<thead>
<tr>
<th>PVC Minimum Shop Seam Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Style</strong></td>
</tr>
<tr>
<td>Heat Bonded Seam Strength</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Heat Bonded Peel Adhesion Strength</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PVC Minimum Field Seam Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Style</strong></td>
</tr>
<tr>
<td>Bonded Seam Strength</td>
</tr>
<tr>
<td>Test Temp 23C, 73F</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Peel Adhesion</td>
</tr>
<tr>
<td>Test Temp 23C, 73F</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The geomembrane shall be protected from wind uplift during installation through the use of sand bags or other suitable weights.

For under raft foundations, 50mm thick screed layer shall be laid on top of a vapour barrier before casting the concrete for foundation.

For retaining walls concrete shall be casted directly on the non woven felt and the protection board.
WATERPROOFING (07100) (CONT'D)

G. Workmanship (Cont'd)

6. Flashing Installation

Install flashings in accordance with manufacturer's instructions SMACNA Architectural Sheet Metal Manual Requirements.

Weather lap joints minimum 150mm and seal with mastic. Secure in place with nails at 300mm with concealed fasteners.

Flash and seal work projecting through or mounted on roofing with mastic. Provide weather tight installation.

Form flashings to profiles required by the Engineer.

Form sections square, true and accurate to profile, in maximum possible lengths, free from distortion and other defects detrimental to appearance or performance.

Hem exposed edges of flashings minimum 6mm on under side.

Apply bituminous paint on concealed surfaces of flashings.

All pipes, conduits, sleeves and other projections passing through membrane shall be flashed to provide tight construction throughout.

7. Gravel

Gravel shall be laid up to a minimum 50mm thick using a guide board to obtain a uniform thickness.

8. Testing

The horizontal areas of waterproofing membrane shall be water flood tested after plugging all drains, for a period of 48 hours. Dry area where leaks occur shall be drained thoroughly dried, repaired and then retested at no additional cost to the Employer. Testing certificate shall be issued upon handing over of the works.

9. Completion

Leave all waterproofing clean on completion. Debris will not be accepted.
CEMENTITIOUS WATERPROOFING (07180)

A. **Scope**

Special care shall be taken to check all the concrete surfaces for adequate preparation. Work under this section shall include but not limited to:

- Water tanks

B. **Performance and Standards**

The Contractor shall provide water and shall test the water tanks for one week. Any leak or water seepage shall be repaired at no additional cost to the Employer.

C. **Related Items**

03500 Beds and Screeds  
09220 Portland Cement Plaster

D. **Submittals**

1. Prior to commencing work the Contractor shall obtain from the manufacture full fixing instructions which shall be handed to the Engineer.

2. The Contractor shall carry out a sample area minimum 10m² including repair mortar, water resistant paint, work to pipe penetration and angles for approval of the Engineer prior to commencing work.

3. The Contractor shall execute and deliver to the Employer before the certificate of completion, a written warranty in an approved form, stating should any defects develop during the warranty period, the Contractor shall replace or satisfactorily repair such defects, including adjustments to adjacent work as required at the convenience of and without expense to the Employer. The warranty period shall extend 5 years from the date of certificate of completion.
CEMENTITIOUS WATERPROOFING (07180) (CONT’D)

E. **Product Handling**

All products shall be carefully handled at all times during transportations, storing on site to prevent damage.

All materials shall be maintained in condition which shall in no way cause deterioration of the material.

Any damaged or defective items shall be removed from Site and replaced at no additional cost.

All products shall be delivered clearly marked and stamped with the manufacturer’s brand.

F. **Materials**

1. **Water Resistant Paint**

The water resistant surface treatment shall be a two component, non-toxic cementitious coating when used for potable water tanks. The surface treatment shall comply with the following requirements:

- Tensile strength: ASTM C-190  5.0 N/mm²
- Compressive strength: ASTM C-109  39.0 N/mm²
- Flexural strength: ASTM C-348  11.0 N/mm²
- Bond strength: ASTM C-321  3.5 N/mm²
- Shear bond strength: ASTM C-109  5.5 N/mm²
- Abrasion resistance: ASTM C-241  1.15 % Wt. loss
- Impact strength: 16.0 Inch-Pounds

In addition, the surface treatment shall be resistant to a wide range of industrial chemicals.

G. **Workmanship**

1. **Preparation of Concrete**

All areas to receive the water resistant surface treatment shall be delineated and clearly marked out prior to the commencement of the works.

All areas to receive the water resistant surface treatment shall be clean, dry and free from all contamination. The areas shall be sound and free of surface laitence. Any contamination or laitence shall be removed by suitable mechanical means prior to the application of the surface treatment.
CEMENTITIOUS WATERPROOFING (07180) (CONT’D)

G.  

Workmanship (Cont’d)

1. Preparation of Concrete (Cont’d)

   All dust or surface debris from the preparation processes shall be thoroughly cleaned off the substrate prior to continuing.

   All surfaces to be treated shall be pre-soaked with clean water immediately prior to the application of the water resistant surface treatment. Application of the surface treatment over dry or insufficiently wetted areas shall not be permitted.

   All surfaces to receive the application shall be thoroughly wetted using large volumes of clean water.

   The application shall be in accordance with the manufacturer’s recommendations.
THERMAL INSULATION (07200)

A. Scope

1. Provide labour, materials, equipment and services, and perform operations required for installation of Insulation and related work as indicated on the drawings and specified herein.

2. Work Included

   The work of this section will include, but not be limited to, the following:

   - Roof insulation to waterproofing system.

B. Performance and Standards

1. Materials and work shall conform to applicable codes and standards.

C. Related Items

   07100 Waterproofing
   07300 Roofing Tiles

D. Submittals

1. Product Data

   Submit copies of manufacturer's latest published literature for materials specified herein for approval and obtain approval before materials are delivered to the site. Include copies of certified test reports showing compliance with specified performance values, including R-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

2. Submit samples, as requested by the Engineer, of all materials specified herein in accordance with the requirements of the Contract.
THERMAL INSULATION (07200) (CONT'D)

E. **Product Handling**

1. Deliver materials to the site in original unopened packages clearly indicating manufacturer's name, brand name and other identifying information.

2. Store materials in a dry location off the ground and in such a manner as to prevent damage or intrusion of foreign matter. Replace damage or unfit materials at Contractor's expense.
   
a. Do not expose insulation to sunlight, except when necessary during period of installation and concealment.

b. Protect insulation against ignition. Do not deliver insulating materials to project site ahead of installation time. Complete installation and concealment of materials as rapidly as possible in each area of work.

F. **Materials**

1. **Extruded Polystyrene Board Insulation for Roofs**

   Rigid, cellular thermal insulation 50mm thick to the approval of the Engineer with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process having thermal resistance coefficient R=1,1/m². Comply with ASTM C578 for type indicated; 5 year aged R-values of 5.4 and 5 at 5 and 25 degrees C (40 and 75 degrees F).

   Alternative material may be submitted for approval.

G. **Workmanship**

1. **Examination**

   a. Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

   b. Verify that required work and penetration of surfaces have been completed prior to commencement of work.
THERMAL INSULATION (07200) (CONT'D)

G. Workmanship (Cont'd)

2. Preparation

Surfaces receiving thermal insulation shall be firm, smooth, fully cured, clean and dry. Holes, joints and cracks shall be pointed flush with mortar. Cut or ground high spots smooth. Clean surfaces of dust and foreign matter. Surfaces shall be in proper condition for satisfactory installation of the thermal insulation.

3. Installation

a. Comply with manufacturer's instructions for particular condition of each installation. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

b. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions. Fill voids with insulation. Remove projections which interfere with placement.

c. Apply a single layer of insulation of required thickness unless otherwise shown or required to make up total thickness.

d. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive.

4. Cleaning and Protection

a. Upon completion of the work, remove unused materials, containers, equipment, etc., from the site. Damage shall be repaired and work and adjacent surfaces shall be left in a clean, undamaged condition.

b. Protect completed work from damage by subsequent building operations and effects of weather. Protection shall be by methods recommended by the manufacturer of installed materials and as approved by the Engineer.
ROOFING TILES (07300)

A. **Scope**

This work shall include the supply and fixing of precast cement roofing tiles laid loose on flat roofs in selected locations.

All as shown on the drawings and to the approval of the Engineer.

B. **Related Items**

07100 Waterproofing
07200 Thermal Insulation

C. **Submittals**

1. **Shop Drawings**

   a. The Contractor shall prepare and submit complete shop drawings of the work included herein for the Engineer’s approval. Shop drawings shall include profiles, sizes and reinforcing. Shop drawings shall be submitted as directed by the Engineer.

   b. All installed materials shall conform to the approved corresponding shop drawings.

2. **Samples**

   a. Samples of materials proposed to be used, shall be submitted by the Contractor for Engineer’s approval. Samples shall indicate finishes proposed to be used and shall be submitted on material on which they will be applied. Samples shall be submitted as directed by the Engineer.

   b. All installed materials shall conform to the approved corresponding samples.

   c. Field mock-up of roofing tiles shall be performed at the site where directed by the Engineer. The field mock-up shall be of sizes directed by the Engineer. The field mock-up shall indicate the sizes, colour and finish of each type of roofing tiles, laying patterns, and jointing including supports and fixing accessories.
ROOFING TILES (07300) (CONT’D)

C. **Submitals (Cont’d)**

3. **Field Mock-Up**
   a. Field mock-up panel shall be erected on the site where directed by the Engineer.
   b. Mock-up panel shall be as directed by the Engineer and shall indicate the colour and finish of different roofing tiles.
   c. The field mock-up shall be immediately revised by the Contractor during the presence of the Engineer, if the Engineer so directs, until the field mock-up is approved by the Engineer. All installed materials shall conform to approved corresponding field mock-up. The field mock-up shall remain intact until its removal is directed by the Engineer, and subsequently, shall be removed by the Contractor.

4. **Measurements**

The Contractor shall take all necessary measurements at the building as required to assure proper installation of the work of this section.

5. **Coordination**

All work of this section shall be closely coordinated with the work of other sections whose work affects or is affected by the work specified in this section.

D. **Materials**

1. **General**
   a. **Cement**

   Conforming to BS 12, or ASTM C150 Type I, non staining.

   b. **Aggregate (Fine and Coarse)**

   Conforming to BS 882, or ASTM 33 of material, colour and proportions conforming to approved sample. Aggregate shall be clean, hard, strong, durable, inert materials, free of deleterious substances.
ROOFING TILES (07300) (CONT'D)

D. Materials (Cont'd)

1. General (Cont’d)
   c. Water

   Clean and free from injurious amounts of oils, alkalis, organic materials, and other deleterious substances.

   d. Air-Entrainment Admixture

   Shall be approved by the Engineer.

2. Precast Cement Tiles

   a. Precast cement tile units shall be of concrete with a minimum compressive strength of 2500 pounds per square inch at 28 days.

   b. Tiles may be obtained from a locally available cement tiles producer.

   c. Testing of units for conformance with strength and water penetration requirements shall be performed by the Contractor to the satisfaction of the Engineer.

   d. Precast cement roofing tiles shall be square or of other shape if required size shall be 600 x 600 x 40mm thick.

   e. Colour and Finish

      1. Colour of tiles items shall be as directed by the Engineer.

      2. Finish of roof tiles shall be smooth without pits, fins, voids, or cracks.

G. Workmanship

1. Examination of Surfaces and Conditions

   a. All surfaces which will receive the work of this section and all conditions which affect the work of this section shall be carefully examined by the Contractor prior to installation of the work of this section. Starting installation on any surface shall be construed as an acceptance of such surface and acceptance of all prevailing conditions, and as a waiver of any subsequent claim to the contrary.
G. Workmanship (Cont'd)

2. Installation
   a. All precast cement tiles shall be installed loose as shown on the drawings.
   b. Tiles shall be installed level, with adjacent faces flush and joints straight and aligned.

3. Protection
   a. All work of this section, and related adjacent construction, shall be protected from damage, staining, or other imperfections at all times. Damaged, stained, or imperfect materials shall be repaired or replaced as directed by the Engineer without cost to the Owner.

4. Cleaning
   a. All exposed surfaces of the work of this section and related adjacent surfaces shall be maintained in a clean condition, and upon substantial completion of the Contract shall be thoroughly cleaned to the satisfaction of the Engineer.
STAINLESS STEEL CLADDING (07462)

A. **Scope**

Work of this section relates to but is not limited to design, supply and installation of stainless steel cladding and associated works as shown on the drawings.

B. **Performance and Standards**

1. **General**

   The Contractor is to note that a high standard of finished workmanship and precision in assembly and fixing of components is required and that an exceptional degree of care will be needed to reach the required standard.

   Use a firm with not less than 10 years successful experience in producing materials or components and installation for required work.

   Where a choice of manufacturer or source of supply is allowed for any particular item, the whole quantity required to complete the works must be of the same type, manufacturer and/or source, and shall not be changed without agreement in writing. Produce evidence of sources of supply when requested by Engineer.

2. **Design Standards**

   Any query concerning requirements of any regulations or design standards governing installation of works shall be made known to Engineer by Contractor and clarified prior to commencement of actual installation.

3. **Life Expectancy**

   Provide materials and systems that have a minimum life expectancy to first maintenance operations of 20 years.

   For the purpose of this requirement the term “maintenance” is deemed to exclude periodic cleaning of external surfaces and lubrication, but to include rectification of faults due to short comings in design, manufacture or deterioration of performance.
STAINLESS STEEL CLADDING (07462) (CONT’D)

B. Performance and Standards (Cont’d)

5. Water Penetration

Include in design measures to prevent dirt staining or streaking caused by flow of water over elevations.

It is required that the completed installation be sound and watertight.

Include for discharge of rainwater from any location where it might collect, calculating capacity and rate in accordance with BS 6367 based on a rainfall rate of 75mm per hour. Do not permit standing water.

6. Materials

Materials are to be of a suitable nature and quality in relation to the purposes and conditions in which they are used and applied or fixed, so as to perform adequately their intended function.

7. Design

Contractor is to design supports for external sheeting to meet performance requirements given herein and BS 449: Part 2, Addendum No. 1. Conform with any overall dimensions shown and adjust thickness and gauges as necessary.

8. Wind Loading

Where subject to wind loading provide systems capable of withstanding without failure wind loadings to be expected at this site calculated in accordance with CP3: Chapter V: Part 2.

9. Loadings

Provide systems capable of withstanding without failure loadings to be expected for particular application in accordance with BS 6399 Part 1 and Part 3.

Units and systems are to be capable of transferring all dead and live loads imposed on them to main structure via sufficient permanent joints.
STAINLESS STEEL CLADDING (07462) (CONT’D)

B. Performance and Standards (Cont’d)

10. Temperature and Humidity

System is required to perform without reduction of performance under following ambient conditions:

a. External Design Conditions: to be expected in use:

   Summer } Maximum 50°C
   Winter  } Minimum -5°C

Design and provide for contraction and expansion of component materials as will be caused by surface temperatures to be experienced in service without causing buckling, stresses on other materials, failure of joint seals, undue stress on structural elements, damaging loads of fasteners, or other detrimental effects.

11. Movement Joints

Incorporate inconspicuous movement joints in systems to accommodate both thermal and building movement so as to avoid distortion or damage of units or system or adjoining structure and to permit continuance of any movement joints in building structure. Incorporate a method of accepting structural movement under imposed or wind loading to avoid damage to system; similarly incorporate methods of accommodating natural shrinkage and creep that might occur in building frame.

12. Fixing Accessories

Adopt completely concealed fixing methods as a principle throughout work. If in isolated cases exposed fixings are unavoidable take particular care to locate these in unobtrusive positions with heads of fasteners countersunk and finished to match adjoining surfaces.

13. Protection

Protect all components from adverse weather conditions especially against sea deterioration effects.

C. Related Items

05500 Miscellaneous Metals
07900 Joint Sealers
D. Submittals

1. General

Well before commencing manufacture of units and in sufficient time for Engineer to assess samples of a complete cladding or covering. Installation to comprise wall cladding or covering to a width of 3m complete with all flashings and sealants. Provide all necessary supports, frames, etc..

Locate job samples so that they are exposed to natural weathering such as will be expected for finished work, and so to prevent soiling due to building operations.

 Obtain agreement of samples before carrying out remainder of work. Once a sample has been agreed by Engineer for general appearance provide work at least equal to that of agreed sample.

 Maintain samples on site and remove and dispose of when instructed by Engineer.

 Allow sufficient time for Engineer’s agreement to be given to samples before deliveries are made to site.

 Submit manufacturer’s specifications for each type of material proposed stating country of origin. Include manufacturer’s published data, certificate and/or laboratory test reports indicating that each material complies with requirements. Include representative samples showing material, profiles, and colours.

 Submit name of any specialist firm Contractor proposes to use for supply of these items together with details of their methods and plant and recent work illustrating their competence, experience and suitability.

2. Samples

Submit two samples each of materials forming fire and/or smoke stops/insulants, proposed fixing materials including bolts, nuts, spacers, anchors, cleats, screws, rivets, etc. as and when requested by Engineer.
**STAINLESS STEEL CLADDING (07462) (CONT’D)**

**D. Submittals (Cont’d)**

2. **Samples (Cont'd)**

   Before commencement of work submit samples of following materials to Engineer:

   1. Profiled wall cladding sheeting, of sufficient size to indicate profile and construction.

   2. Fixing accessories.

3. **Maintenance Requirements**

   Submit details of maintenance requirements for all materials proposed stating also methods of repair in event of damage.

**E. Product Handling**

Store handle and protect materials or components in accordance with manufacturer’s recommendations.

Do not deliver to site any components which cannot be immediately unloaded into suitable conditions of storage.

Deliver and handle materials and components so as to avoid overstressing, distortion and damage.

Do not allow any material to cause overloading of structures.

Protective measures required for pre-finished metal sections or components are to be applied in factory; include additional measures such as crating for protection during handling and transportation.

Deliver colour coated/painted/pre-finished items in protective wrappings and casings that will not damage stain or mark any significant surface.

Protect all corners edges and finished surfaces to avoid damage until fixed into position.

Protect materials from damage and store in dry, cool, well ventilated area.
STAINLESS STEEL CLADDING (07462) (CONT’D)

F. **Materials**

1. **Stainless Steel**

   Stainless steel cladding shall be 2mm thick and 3mm thick, brushed matt and polished finish as shown on the drawings and indicated in Bill Items and shall be obtained from supplier approved by the Engineer all in accordance with BS5427.

2. **Sound Transmission**

   Test result shall be in conformity with ASTM E-413.

3. **Sealing Tapes and Sealants**

   Refer to section 07900 "Joint Sealers".

4. **Isolating Tape**

   To be self-adhesive flame retardant, PVC (polyvinyl chloride)/PTFE (Polytetrafluoroethylene), or as recommended by sheeting manufacturer, to separate dissimilar metals to prevent galvanic corrosion or electrolytic action.

5. **Cladding and Covering Supports**

   Metal purlins sizes as recommended by sheet manufacturer, and designed to suit temperature and loading conditions to be expected on site.

   Stainless steel and galvanized steel supports shall be used for stainless steel cladding as shown on the drawings.

6. **Metal Accessories**

   Refer to Metal Materials section 05010.
STAINLESS STEEL CLADDING (07462) (CONT’D)

G. Workmanship

1. General

Inspect surfaces to which cladding or covering is to be attached and report any unsatisfactory conditions to Engineer. Do not proceed with work until unsatisfactory conditions have been corrected.

Comply with manufacturer’s instructions except when required of BS or CP or those contained herein are more restrictive when abide by Engineer’s decision and provide a wind and watertight installation.

2. Side Laps

Secure long edges of each sheet to each adjoining sheet at centres not exceeding 450mm and/or as recommended by sheeting manufacturer. Make side laps of at least one corrugation, and so that underlying corrugation is supported at its free edge on each sheeting rail. Side laps to be riveted by sealed rivets complete with colour caps to match cladding colour, and sealed with double lines of 12mm x 2mm tape, and/or as recommended by sheeting manufacturer.

3. End Laps

Fix sheeting with as few end joints as possible, and lap or otherwise join, to prevent wind and water penetration. Where end laps are unavoidable, agree locations with Engineer, and provide over solid supports. End lap covers for vertical wall cladding to be minimum 100mm, and sealed with double lines of 12mm x 2mm tape. Horizontal cladding end laps to be sealed with double lines of 12mm x 2mm tape, and/or as recommended by sheeting manufacturer. End laps in sheets to be fixed to allow for thermal movement.

4. Sealing Laps

Seal laps using sealant or tape that will neither extrude nor be visible in service, and as follows:

a. Seal laps to fittings and filler pieces with the same sealing strip as used between sheeting.

b. Locate sealing strips in position in straight line parallel to edges of sheets.

c. Do not allow sealing strips to stretch or sag into position.

d. Do not damage or disturb seals during drilling and/or fixing.
G. **Workmanship (Cont’d)**

5. **Prevailing Wind**

Generally lap sheets with exposed joints of side laps away from prevailing wind direction.

6. **Cutting and Drilling**

Drill holes for fixings with sharp drills through sheeting and sheeting rail/purlin in one operation. Punching of holes will not be permitted.

Do not make holes larger than necessary to accommodate fixings, and do not elongate except where necessary to accommodate movement. Holes for primary fastenings to be 3mm larger than diameter of fastening unless self-drilling type with pilot point is used.

Place fixings in alignment horizontally and vertically. Cut sheets to give clean, true lines, and remove all swarf arising from drilling, burrs, lubricant, dust and other deleterious materials, before final fixing of sheets.

7. **Location of Fixings**

Drill primary fixing holes in trough/crown of profile of wall cladding sheets, or as recommended by sheeting manufacturer.

8. **Profile Fillers**

Install and position profile fillers and ensure that they fit exactly the contours of the sheeting profile and leave no gaps. Where sealed laps are specified, bed profile fillers in sealant on top and bottom surfaces.

9. **Fixing Systems**

Do not overtighten and use electric powered hand drills fitted with torque limiters or cut-offs to prevent overtightening.

10. **Bared Edges of Steel**

To meet performance/life expectancy requirements, coat and seal cut or drilled bare edges of steel sheets, flashings and accessories with corrosion protection system recommended by manufacturer of sheeting before fixing. Submit details of treatments to Engineer.
G. **Workmanship (Cont’d)**

11. **Flashings**

   Neatly apply flashings in accordance with best forming practices and provide a weathertight finish. Install so that buckling or deformation in service due to expansion and contraction is avoided.

   Fix sheet material in continuous lengths without end joints and where used externally lap or otherwise join to prevent wind and water penetration. When end laps are permitted make over solid supports and prevent wind and water penetration. Laps to be minimum 200mm or longer.

   Apply with long dimension horizontal, lapping each sheet over lower sheet.

   Where turned up against walls and upstands fold flashings and tuck into 25mm deep grooves to a minimum depth of 20mm and secure with folded wedges; seal with 'Plastijoint' by Fosroc Expandite Limited. Do not exceed lengths recommended by Association for metal used without weatherproof and water tight expansion and contraction joint.

   Where a flashing is of such a shape that it cannot be neatly and adequately dressed or formed on site cut and weld in factory.

   Form drip edges to present neat and uniform lines.

12. **Manufacturer’s Instructions**

   Fix sheets, components and accessories in accordance with this specification and manufacturer’s recommendations, except when the requirements of relevant British Standards and British Standard Codes of Practice, or those contained herein are more restrictive, when the more restrictive requirements will apply.

13. **Setting Out**

   Set cladding plumb, level and true to line, without warp or rack, and allow for all shims as necessary. Anchor securely in place at equal centres not exceeding manufacturer’s recommendations. Wall sheets to be plumb and set to a lower edge datum line.

14. **Fixings to Supporting Structure**

   Fix cladding sheeting to supporting structure with stainless steel hook on brackets to the approval of the Engineer.
STAINLESS STEEL CLADDING (07462) (CONT'D)

G. Workmanship (Cont’d)

15. Movement Joints

Provide movement joints over all structural movement joints in building. Leave space between sheets and cover with movement joint cover, to details agreed with Engineer.

16. Thermal Movement

Thermal movement in sheeting to be accommodated by an end lap expansion fixing, including ledge rails, as required, where indicated on drawings. Fix top sheet only through crown/trough of profile, and/or as recommended by sheeting manufacturer.

17. Forming Metal

Do not form on site without Engineer’s consent. Do not hand-form. Use mechanical rolling or braking, or vacuum methods.

18. Supporting Metalwork

Design and provide as necessary between fixing zones as manufacturer’s instructions.

19. Bolting

Follow recommendations in relevant British Standards for strength grade combination of bolt/nut/washer assemblies.

20. Closers and Flashings

Provide purpose made closures or flashings at all openings, tops and bottoms, and other locations required for weather protection. Provide filler blocks to close all open ends.
FLASHING AND SHEET METAL (07600)

A. **Scope**

Extent of Work: The extent of flashing and sheet metal, work is indicated on drawings and as specified herein.

B. **Quality Assurance**

1. Manufacturer: Provide flashing and sheet metal from a manufacturer approved by the Engineer.

2. Codes and Standards: Comply with the applicable requirements of the following:
   a. SMACNA: - Sheet Metal and Air Conditioning Contractors National Association.
      B32 Specification for Solder Metal.

C. **Related Items**

07100 Waterproofing

D. **Submittals**

1. Manufacturer's Data: Submit metal manufacturer's product specifications, installation instructions and general recommendations for flashing and trim applications.

2. Samples: Submit samples of specified flashing or trim.

3. Shop Drawings: Submit shop drawings showing fabrication, jointing and securing of metal to form flashings and trim. Show waterproof connections to adjoining work and at obstructions and penetrations.
FLASHING AND SHEET METAL (07600) (CONT'D)

E. **Product Handling**

Deliver and handle material carefully so as to protect units from damage. Stack units off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects.

F. **Materials**

1. **Miscellaneous Materials and Accessories**
   a. Aluminium sheet and strip to BS 1470 designation N53 3mm thick Temper grade 0, or ASTM b209.
   b. Fasteners: Same metal as flashing/sheet metal or, other non-corrosive metal as approved. Match finish of exposed heads with material being fastened.
   c. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
   d. Adhesive: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
   e. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

2. **Fabrication**: Shop-fabricate flashings and trim units to the greatest extent possible. Fabricate as shown and, to extent not shown, fabricate to comply with SMACA "Architectural Sheet Metal Manual", metal manufacturer's recommendations, and recognized industry practices. For continuous running work, fabricate with expansion joints in flashings, spaced sufficiently close to prevent flashing damage and failure in resistance to water penetration, permanently. Form flashing to fit substrate in each application.
FLASHING AND SHEET METAL (07600) (CONT'D)

G. **Workmanship**

1. **Inspection**

   The Contractor shall examine the substrates and the conditions under which flashing and sheet metal shall be installed and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

2. **Installation**

   a. **General:** Workmanship and installation of flashing and sheet metal work herein specified shall be in accordance with the best practice for sheet metal work.

   b. **Through-Wall Flashing**

      i. **Application:** Bed one layer of through-wall flashing into adhesive. Lay to within 25mm of the outer face of the wall and into a joint of the backing material. Lap flashing material not less than 150mm at joints and seal thoroughly with adhesive.

      ii. **At exterior door heads and in all other places where the flashing is not run continuously in the wall,** the flashing shall be extended at least 200mm behind the jambs of the opening and turned up not less than 50mm by folding (do not cut). It is the intention that all flashing shall drain the water outward, and therefore, the slope if any shall be in that direction. Exercise particular care to keep mastic from exposed surface of the masonry.
CANOPY (07800)

A. Scope

1. This Section specifies all canopies shown on the drawings, constructed in stainless steel elements with laminated glass.

B. Performance and Standards

1. All constituent materials and component parts shall be of the best of their respective kinds, shall withstand the effects of solar radiation, heat, rapid temperature change, humidity, and rain without distortion or material breakdown.

Complete assemblies shall function efficiently in all conditions in accordance with the design intent.

2. The finishes of all materials shall be in accordance with appropriate and relevant clauses.

C. Related Items

05010 Metal First Fixing Materials
05030 Metal Finishes
08800 Glazing

D. Submittals

1. Samples of canopy

The Contractor shall supply for the Engineer's approval such samples of the canopy materials as the Engineer may require. Each sample shall be complete with spiders, fixing straps, building-in lugs, bolts, butts, hook arms and keeps, and all other fixings as shown on the drawings.

When approved the samples shall be retained on site for reference.

2. Stainless Steel Samples

The requirements of Section 05010 Metal First Fixing Materials and Section 05030 Metal Finishes shall apply.
CANOPY (07800) (CONT'D)

E. **Product Handling**

The requirements of Section 08120 Aluminium Doors and Windows shall apply.

F. **Materials**

1. **General**

   Canopies structures shall be stainless steel members complete with glass and glazing by an approved manufacturer to the approval of the Engineer.

2. **Structure**

   Frames and Sections constructed in stainless steel shall be to the specification in Section 05030 Metal Finishes.

   Glass to canopies shall be 16mm thick laminated clear glass. Glass shall comply with the requirements of Section 08800 Glazing.

3. **Fittings**

   All fixing straps, building inlugs, bolts, butts, strap hinges, pivot pins hook arms and keeps, brackets, angles and all other fixing devices shall conform to the requirements of Section 05010, Metal Materials and Section 05030, Metal Finishes.

   The items shall be to the dimensions and forms shown on the drawings, or where not specifically described on the drawings they shall be at the Contractor's discretion subject to sample approval and suitability for the duty to be performed.

4. **Glazing**

   All canopy shall be glazed with glass confirming to the Specification in Section 08800 and using glazing materials and methods therein specified.
G. **Workmanship**

1. **General**

   Workmanship shall be to highest standards.

2. **Installation**

   The canopy shall be securely fixed with all bolts tightened to ensure that fixings of not progressively loosen in the wind conditions that can be anticipated. The Contractor shall determine what may be required in he way of washers, sprung or otherwise, to enhance the rigidity of the assembly.

   Special care shall be taken to ensure that canopy are fixed level and truly horizontally, with a slope as shown on the drawings.

3. **Protection**

   The Contractor will be responsible for the adequate protection of his work until completed and handover, and particular emphasis is placed upon the importance of avoiding any blemishes whatsoever on the finished aluminium faces.

4. **Completion**

   On completion, all work shall be left clean and free from damage or defect, to the satisfaction of the Engineer.
JOINT SEALERS (07900)

A. Scope

1. This section specifies sealants, joint fillers and related products, applied to exterior and interior moving and non-moving joints to prevent penetration of moisture and air or to assist in the reduction of sound transmission.

2. For any joint which is subject to movement, either thermal expansion or dynamic, at which it is necessary to prevent the ingress of water or passage of air whether explicitly shown on drawings or not, the Contractor shall provide and apply the appropriate sealant or caulking compound together with compatible and appropriate backing material, joint filler, bond breaker tape, etc. Sealants selected shall be compatible with materials with which they are in contact. The work, including preparation of surfaces to receive sealant, shall be in strict accordance with the manufacturer's instructions or recommendations having regard to the conditions of installation and use.

3. The work of this section shall include but not limited to, the following:
   a. Joints between items of equipment and other construction.
   b. Joints between plumbing fixtures and wall surfaces, completely around each fixture.
   c. Edge of waterproofing membrane abutting against walls and penetrations to provide a watertight and airtight barrier.
   d. Sealing and caulking shall include sealants, joint fillers, backer rods, primers, bond breaker tape.

B. Performance and Standards

1. The sealed joint shall not fail to perform as required in terms of air tightness, or fail in joint adhesion, cohesion, abrasion, weather, extension, migration or stain resistance; or fail in general durability or appearance; provided that such failure indicates a standard of performance lower than is specified or can be expected from the manufacturer's data.

2. All materials shall be of a standard not less than that of relevant British Standards where these exist.
JOINT SEALERS (07900) (CONT'D)

C. Related Items

07100 Waterproofing  
08120 Aluminium Doors & Windows

D. Submittals

1. Samples

Samples of each type of sealant, with full range of colours shall be submitted for selection by the Engineer.

A minimum 2m run of sealant in-situ of each sealant material, in each situation, shall be submitted for the approval of the Engineer. Such samples shall include an intersection of mastic runs, where these are to be provided in finished work.

The approved samples shall be retained and protected for reference, and may form part of the finished work.

2. Manufacturers' Recommendations

The Contractor shall obtain the manufacturers' recommendations for use, together with detailed application instructions, for all materials used, and shall issue copies to the Engineer, prior to any sealant application going forward.

3. Warranty

The Contractor shall execute and deliver to the Employer before the certificate of completion, a written warranty in an approved form, stating should any defects develop during the warranty period, the Contractor shall replace or satisfactorily repair such defects, including adjustments to adjacent work as required at the convenience of and without expense to the Employer. The warranty period shall extend 5 years from the date of certificate of completion.
E. **Product Handling**

1. **Delivery**

   Each tin of sealant is to be delivered to Site clearly marked with relevant batch number.

   Records of batch numbers and tins issued to Site are to be kept and are to show in which area contents of tins have been used. These records are to be submitted to the Engineer if called for.

2. **Storage**

   Materials, at all times prior to applications, shall be stored in conditions which shall in no way cause any deterioration or affect the life of the material.

F. **Materials**

1. **Sealant**

   The sealant to be used in each case shall be as shown as detailed below:

   a. Sealant for non-traffic vertical or horizontal surfaces shall be a non-sagging, gun grade sealant. Sealant shall be one of the following types:

   1. Polyurethane: One part polyurethane compound of approved manufacture, with a Shore A cured hardness of 25 plus or minus 5, conforming to Federal Specifications TT-S-00230C, Type II, Class A + 25% movement capability, ASTM C-920-87. Colours to match adjacent materials from manufacturer's standard colours.


F. **Materials (Cont'd)**

1. **Sealant (Cont'd)**
   
   b. Sealant for interior and exterior horizontal traffic surfaces shall be non-staining, pourable and self-levelling. Sealant shall be two-part polyurethane compound of approved manufacture, with a Shore A cured hardness of 35 plus or minus 5, conforming to Federal Specifications TT-S-00227 E, Class A, type I and ASTM C920. Sealant shall have a joint movement capability of plus/minus 50 percent. Colour to match adjacent materials from manufacturer's standard colours.

2. **Bond Breaker:** Forced, non-absorbent polythene backing strip.

3. Primers and cleaners for the various surfaces to which sealants are to be applied shall be of types recommended by the approved manufacturer. Primers and cleaners shall not damage applied metal finishes.

G. **Workmanship**

1. **Tools and Plant**

   Provide all necessary special plant and tools required to clean and properly prepare the recesses to be sealed, also as required for the proper application of the sealants. All such tools and plant to be obtained from or approved by the approved sealant manufacturers.

2. **Preparation**

   All joints to receive sealant shall be clean and dry. Horizontal joints shall be vacuum cleaned to remove any debris.

3. **Mixing Sealant**

   Thoroughly mix together the components of 2 part sealants. In hot weather mix in a cool, shaded place. Do not mix, at any one time, larger quantities than can be used within the period stated by the manufacturer.

   Mixing with a mechanical mixer shall be carried out at low speed to avoid air bubbles and a rise in temperature leading to premature curing.
JOINT SEALERS (07900) (CONT'D)

G. Workmanship (Cont'd)

4. Gunning Sealant

Extrude sealants firmly from the gun; fill joints completely from inside outwards, so as not to entrap air. In the event of difficulties in 'wetting' and gaining adhesion to the adjacent faces, replace contents of gun with new batch of sealant.

Work sealants into joint with wetted palette knife, pressing home and scraping off surplus.

Check sealant within a few days of application, particularly at horizontal joints, for sag, loss of adhesion or other faults. Make good any such defects immediately.

5. Finishing

Clean off adjacent surfaces, ensuring that no sealant or cleaning solvent remains on the surface.

In carrying out this work, only use materials recommended by the sealant manufacturer, ensuring that no solvent or similar material comes into contact with the sealant within the joint. Abrasive materials which can cause damage shall not be used.

6. Protection

Protect the jointing from dust and inclement weather until the sealant has completely set. Continue protection where necessary to prevent damage from building operations, trafficking etc., until completion of the Works.
DIVISION 8

DOORS AND WINDOWS

STEEL DOORS (08110)

A. **Scope**

This work shall include the general requirements for the supply, installation and fixing of hollow metal steel doors, and knock down wrap around steel frames for single and double leaf doors from Galvanised steel sheets, and protective coating suitable for internal or external use as shown on the plans and door schedules.

This work shall also include hollow metal access doors and panels with four sided corner welded steel frames for single and double leaf doors with 2 hours fire resistance rating, for accessing mechanical, electrical and other concealed items requiring maintenance admission. Manufactured from Galvanised steel sheets, and protective coating suitable for internal or external use.

The term "doors" in this section shall also include access panels and frames manufactured in steel.

B. **Performance and Standards**

1. Steel Doors and frames shall comply with BS 1245. All steel sheets shall comply with BS4630 and with BS4, Part 1, and with BS1449, part 1.

2. Standards:

   a. BS 455 & 2088: Locks and Latches for doors and performance requirements.

   b. BS2377: Hinges

   c. BS 1331 & 4112: Hardware for Housing and performance tests.

3. Fire Rating:

   All fire rated doors are to be tested and certified by an accredited fire testing laboratory, to comply with BS 476 parts 20 & 22.

   All hardware used on fire rated doors should comply to same standards of fire rating as doors and in specific of same fire rating hours.
STEEL DOORS (08110) (CONT'D)

B. **Performance and Standards (Cont'd)**

4. Quality Insurance:
   
a. Provide steel doors and frames as manufactured by a single firm specializing in the production of this type of product.
   
b. Applicable standards: comply with British standards.
   
c. Fire rated doors: provide doors that have been tested by an independent testing and inspection agency along with test certificates complying with BS 476 parts 20 and 22.
   
d. Supplier (Local agent or local manufacturer) should submit evidence of having executed at least three projects of similar nature and complexity, preferably in Lebanon, and having an experience of min 3 (three) years in such a trade.

C. **Related Items**

05010 Metal First Fixing Materials
05030 Metal Finishes
08700 Ironmongery
09900 Painting

D. **Submittals**

1. **Samples of Doors**

   The Contractor shall provide for the Engineer's approval one sample, 200mm long, of each separate profile that is to be used in the work.

2. **Product data:** for each type of door and frame specified including details of construction, materials, dimensions, hardware preparation, core, product compliance with general fire rating requirements, profiles and finishes.

3. **Shop drawings:** showing fabrication and installation of steel doors and frames, include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware reinforcements, and details of joints and connections, show anchorage and accessory items.

4. **Door Schedule:** Submit schedule of doors and frames using same reference numbers for details and openings as those on contract.
STEEL DOORS (08110) (CONT'D)

D. Submittals (Cont'd)

5. Oversize Fire-rated doors: For units exceeding sizes mentioned on certificate of tested assemblies, provide certification assessment by a testing agency acceptable to authorities that doors conform to all standard construction requirements of tested fire rated doors.

6. Ironmongery: Samples of all approved ironmongery associated with steel doors shall be supplied to the manufacturer of the doors to ensure that proper provision is made for their fixing, and all details are to be given to the manufacturer as to which items apply to which frames. The samples and information to be given to the manufacturer before production is commenced.

E. Product Handling

1. Handling Generally

All doors shall be carefully handled at works, during transportation and storage and on site to prevent damage. Any damaged or defective units shall be removed from the site and replaced at no additional cost.

Inspect hollow metal steel units up on delivery for damage, Minor damages to be repaired, provided the finished items are equal in all respects to new work and acceptable to the Engineer, otherwise, remove and replace damaged items as directed.

2. Identification

All doors shall have suitable identification in terms of the door frame schedule marked on them or attached in such a way that the labeling will not easily become detached. For knock down frames identification must be marked on the three parts of the frame. Crates shall similarly clearly identify their contents.

3. Protection

The doors are to be suitably protected and crated to prevent damage during transportation and storage. The protection shall be such that doors are not subject to damp.

4. Storage

Store Hollow metal steel units on raised platforms, in vertical positions with blocking between units, to allow air circulation, keep stored material covered and protected from damage and environmental conditions.
STEEL DOORS (08110) (CONT’D)

F. **Materials**

1. **Approved Suppliers**

   Roots Group, Lebanon  
   Martin Roberts - Ingersol Rand Co. - UK  
   or approved equal.

2. **General**

   Doors shall be manufactured from metal angles, plate & sheets, and shall comply with BS4, Part 1 and BS 1449, Part 1. Dimensions and frame profiles shall conform to the detail drawings.

   All doors shall be in continuous hot-dip galvanized steel zinc coated. The profiles for the manufacture of steel door frames shall be formed from galvanized steel sheets, complying with the requirements of BS 1449; part 1, not less than 1.2mm nominal thickness.

   For all access doors with less than 40cm rough opening width check manufacturer’s standard for suitable designs that complies with the fire rating requirements.

3. **Welding**

   Welding shall be in accordance with BS 693 or BS 5135 as appropriate.

4. **Corrosion inhibiting coatings:**

   a. Shop primer compatible with respective specified finish paint.

   b. Finish paint to be applied at the building site after installation. Powder coating is not accepted.

5. **Inserts, Bolts and Fasteners**

   Manufacturer’s standard units suitable for the function required.
STEEL DOORS (08110) (CONT’D)

F.  Materials (Cont’d)

6.  Fabrication General
   a.  Fabricate hollow steel units to be rigid, neat in appearance and free from defects, wrap or buckle. Accurately form steel to required sizes and profiles. Whatever practical, fit and assemble units in the manufacturer’s plant. Clearly identify work that cannot be permanently factory assembled before shipment, to ensure proper assembly at project site, weld exposed joints continuously, grind, dress and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

   b.  Exposed Fasteners: Counter sink heads of exposed screws and bolts.

   c.  Finish hardware preparation: prepare hollow steel units to receive mortised and concealed finish hardware, including cut outs, reinforcing, drilling and topping in accordance with final finish hardware schedule and templates provided by the hardware supplier, comply with applicable requirements of British standards.

   d.  Locate Finish hardware as shown on final shop drawings.

7.  Shop Painting
   a.  Clean, treat and paint surfaces of fabricated hollow steel units, whether concealed or exposed in the finished work.

   b.  Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of shop paint.

   c.  Apply a shop coat of epoxy primer paint within time limits recommended by the paint manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.05mm (0.002in; 2mils).

8.  Hollow Metal Doors:

   All doors shall be in continuous hot-dip galvanized steel zinc coated. The profiles for the manufacturer of steel doors / frames shall be formed from galvanized steel sheets, complying with the requirements of BS1449; part 1, not less than 1.2mm nominal thickness.
F. **Materials (Cont’d)**

8. **Hollow Metal Doors: (Cont’d)**

a. Fabricate interior hollow metal doors and access panels with closed cell, 45mm leaf thickness fabricated from 1.2mm galvanized steel sheets.

b. Top and Bottom edges of the door shall be closed with horizontal channel stiffeners welded to the face sheets. Top and bottom channels will be inverted to create a flush edge on top and bottom. Addition of inverted channel will not be acceptable.

c. Hollow metal fire rated doors shall be internally reinforced with pairs of hat shaped vertical stiffeners of 0.75mm thick steel, full height, spaced not more than 150mm on center and spot welded on to space sheets at 100mm on center. Voids between stiffeners shall be completely filled with rock wool insulation to provide sound and thermal insulation.

d. Hollow metal non-fire rated doors: Provide doors with a closed cell, water proof foamed in place polyurethane core completely filling the inside of the door.

e. Door shall be full flush construction with a tight hemmed vertical seam on lock and hinge edges. Edge seams may be filled with metallic filler to attain seamless edge construction if required.

f. Exterior door shall have flush top and bottom caps to retard moisture penetrating the door.

g. Exposed joints shall be fully welded, filled and ground smooth.

h. Door Louvers, where indicated on the drawings or schedules, shall be fabricated integrally with the door. Non fire rated Louvers shall be constructed of spot welded 1.5mm (minimum) cold rolled steel sections, comprising semi-concealed perimeter frame and “Z” type Louver blades. Louvers shall be of size and height as indicated, and located centrally in door width.
STEEL DOORS (08110) (CONT’D)

F. Materials (Cont’d)

8. Hollow Metal Doors: (Cont’d)

i. Vision panels, where indicated on the drawings or schedules, shall be fabricated integrally with the door, size and glass type and thickness as engineers request. Vision panels shall be of size and height as indicated on shop drawing, and located centrally in door width.

j. Provide astragals for fire rated double doors, and to be located on the inactive leaf in order not to interfere with the lock strike when closing the door.

k. Reinforce each door for finish hardware as scheduled conforming the British standard product standard.

9. Steel Door Frames:

a. Fabricate frames, to be knock down wrap around (with mitred corner), each frame shall consist of two Jambs and a head member from 1.5mm galvanized steel sheets, unless otherwise indicated. Corner welded type frames are acceptable if required and applicable to site conditions.

b. Frames for cubical doors shall be wrap around and consists of two side jambs, frame profile, and other details as indicated on shop drawings.

c. Provide double egress frames check drawings and hardware schedule for further details.

d. Provide groove type frames with rubber seals check drawings and hardware schedule for further details.

e. Finish hardware reinforcement: Reinforce frames for required finish hardware conforming to British standard product standard and provide cover bases at the back of all hardware cut outs.

f. Furnish the appropriate anchors as required to match the wall construction. Formed of not less than 1.2mm sheet. Spacing shall conform to British standard product standard.

g. Head Anchors: Provide two(2) anchors at head of frames exceeding 107cm wide for frames mounted in precast concrete walls or metal studs.
STEEL DOORS (08110) (CONT’D)

F. Materials (Cont’d)

9. Steel Door Frames: (Cont'd)

h. Floor anchors: Provide floor anchors for each jamb which extends to the floor, formed of not less than 1.5mm steel sheet and as follows:

i. Monolithic concrete slabs: clip type anchors, with 2 holes to receive fasteners, welded to bottom of jamb and mullions.

ii. Separate topping concrete slabs: Adjustable type with extension clips. Terminate the bottom of frames at the finish floor surface.

i. Spreader Bars: Provide 2 removable spreader bars for corner welded frames across the bottom of frames, back welded to jambs and mullions.

j. Rubber Door Silencer: Drill stops to receive 3 silencers on single door frames and 2 silencers, each side on double door frames. Install plastic plugs to keep holes clean during construction.

10. Steel Access Doors Frames:

a. Fabricate frames, to be four sided corner welded frames, full welded unit construction, with mitered reinforced and continuously welded to the full depth and width of frame from 1.5mm galvanized steel sheets, unless otherwise indicated.

b. Each frame consists of two side jambs, one top jamb and one bottom jamb.

c. Finish hardware reinforcement: Reinforce frames for required finish hardware conforming to British standard product standard and provide cover bases at the back of all hardware cut outs.

d. Furnish the appropriate anchors for the four sides of the frame as required to match the wall construction. Formed of not less than 1.2mm sheet. Spacing shall conform to British standard product standard.

e. Rubber Door Silencer: Drill stops to receive 3 silencers on single door frames and 2 silencers, each side on double door frames. Install plastic plugs to keep holes clean during construction.
STEEL DOORS (08110) (CONT’D)

F.  Materials (Cont’d)

11. Submitted reports:
   a. Test report according to BS 476 part 20 & part 22, is to mention clearly the details of door / frame specifications.
   b. Test report is to cover all requested door sizes as per schedule.
   c. Fire rated doors with vision panels or louvers shall be covered by a test report showing size limitation.

G.  Workmanship

1. Installation:

   Install hollow metal steel units and accessories in accordance with final shop drawings and manufacturer’s data, and as here in specified.

   a. Setting Anchorage Devices:
      i. Provide anchorage devices where required for securing hollow metal frames to other construction.
      ii. Set anchorage devices opposite of each anchors location, in accordance with details on final drawings and anchorage device manufacturer’s instruction. Leave drilled holes rough, not reamed, and free from dust and debris.
      iii. Floor anchors maybe set with power-activated fasteners, instead of masonry anchorage devices and machine screws.

   b. Placing Frames: Set frames accurately in position. Plumb, align and brace securely until permanent anchors are set.

   c. Fill Dimples in Frames, screws and bolts using metal filler. Grind smooth and apply primer paint, dimples shall not show in the finished work.

   d. Door Installation:
      i. Fit hollow metal steel doors accurately in their respective frames, within the following clearances:
         - Jambs and head :3mm
         - Meeting edges, pair of doors :3mm
         - Bottom, the undercut height is as indicated on the shop drawings.
      ii. See finish hardware as indicated on shop drawing or hardware schedule for finish hardware installation.
G. **Workmanship (Cont'd)**

2. **Adjust and clean:**
   
   Final adjustment: Check and readjust all operating finish hardware items in hollow metal work prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including door or frames which are wrapped, bowed or otherwise damaged.

3. **General Quality of Finished Work**

   Any parts of the installation which are indented, distorted, out of alignment, visible welds not ground flush, or defective in any way shall be rejected and replaced at no additional cost or made good to the satisfaction of the Engineer.

   Any damage to the corrosion inhibiting coatings shall be made good immediately on completion of the frame fixing.

4. **Painting**

   Prime coat touch-up: Immediately after erection, sand smooth any rusted or damaged areas of the prime coat of paint and apply touch-up of a compatible air drying primer paint.

   Frames and doors shall be painted on site in accordance with decoration schedules and with the Specification for Painting in section 09900.
ALUMINIUM DOORS AND WINDOWS (08120)

A. **Scope**

1. The work includes the supply, installation and fixing of aluminium doors, windows, louvers, mullions, framing including protruded frames and members and associated work, in accordance with the design drawings.

2. The term "doors and windows" in this section shall also include screens, shop fronts, entrances, louvers, grilles and frames manufactured in aluminium as shown on the drawings and as indicated in the Bills of Quantities.

3. The doors and windows shall be obtained from an approved manufacturer and shall be constructed using his standard components and methods of assembly when these have been agreed on submission of design and shop drawings and such samples as are specified here or called for by the Engineer. They shall incorporate all necessary ironmongery, fixing components, operating gear and weather stripping glass.

B. **Performance and Standards**

1. Materials, Goods and Workmanship shall be of the best quality of their respective kinds, and those for which there is a British Standard or Code of Practice shall comply therewith unless otherwise stated. All articles and materials are to be not less than those standards contained in the latest British Standards Institution Specification where such exists. No Workmanship shall be inferior in any way to the standards laid down in the latest British Standard Codes of Practice.

   All British Standards and Codes of Practice relevant to aluminium work, window, metalwork and to glazing shall be deemed to form part of this Specification in their entirety, or to a limited extent if so directed. A Contractor's ignorance of any of the provisions of the British Standards or Codes of Practice shall in no way be considered to relieve him of his responsibility to comply with them insofar as they apply.

   Materials provided of whatever origin shall comply with the relevant British Standards.

2. The doors and windows shall conform with the requirements of BS 4873.
B. **Performance and Standards (Cont'd)**

3. **Performance**

The Contractor shall have full regard to BS CP 3, Chapter 5, Part 2, Wind Loads, or an equal and approved document when detailing for strength requirements. Reference should also be made in establishing test criteria to Technical Note No.1, "Performance Requirements for Windows", published by the DOE.

Test methods shall be in accordance with BS 5368, depending on the ability to test in the available rig. the procedures in BS 5368 shall preferably be used.

All aluminium openings shall withstand the thermal movement lateral impact force of 900 joules and wind load of 170 Kg/m²

a. **Strength**

All doors and windows and spandrel elements shall be capable of resisting sporadic pressures from wind gusts as stated above.

There shall be no fracture or permanent deflection of any part, nor any deterioration of specified performance. The deflection/span ratio of any part of a light shall not exceed 1/250 for glazing. However in a vertical load test a concentrated load of 15 kg acting vertically and applied at the centre of the span of any horizontal sash rail shall not cause a vertical deflection of more than 1/375. The max. deflection in case of double glazing shall not exceed 8mm.

These requirements shall apply when the exposed face is subjected to pressure or to suction.

If so required by the Engineer the Contractor shall state the actual deflection ratio of any part of the light at the specified pressure.

The method of test to establish compliance with the above requirements shall be established by transducer.

b. **Air Penetration**

For the air permeability test the pressure shall be applied to the outside face only of the window. The maximum pressure to be applied shall be 600 Pa.
B. Performance and Standards (Cont'd)

3. Performance (Cont’d)

b. Air Penetration (Cont’d)

For fixed lights the average leakage rate shall not exceed 1m³/h per metre length of perimeter joint.

For opening lights the average leakage rate shall not exceed 6.5m³/h per metre length of perimeter joint.

c. Water Penetration

There shall be no water leakage at a pressure of 200 Pa.

There shall be no water leakage after a repeated gusting test to a pressure difference of 1250 N/m² when tested again with a pressure of 200 Pa.

d. Temperature Conditions

The window may be exposed to variations in ambient still air dry bulb temperature within the extreme limits from -20° C to +50° C.

Any changes in dimension of a window or its parts, due to changes in temperature within the specified limits, shall not affect the performance as specified elsewhere. The Contractor will be required to state the amount of the thermal movement which will occur, and the effect of this movement on the dimensions or shape of system. Allowance should be made assuming that surface temperatures of up to 90° C may be experienced.

e. Movement

There shall be no loss of function or domination of performance as described in this Specification due to:

i. deflection of the window caused by wind pressure,

ii. the design deflection of the building structure,

iii. thermal movement of the building structure.

The design of the fixings, the fixing gap around the window, and manufacturing tolerances shall take full account of the above.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

C. Related Items

05010 Metal First Fixing Materials
05030 Metal Finishes
07900 Joint Sealers
08700 Ironmongery
08800 Glazing
08930 Glazed Aluminium Curtain Walls
10700 Window Washing Systems

D. Submittals

1. Design Drawings

Design drawings prepared by the Engineer shall form the basis of the manufacturer's design of the doors and windows insofar as they show the basic design requirements including size, configuration, type of opening, and other functional and Architectural requirements.

The Contractor shall submit for approval the manufacturer's preliminary design drawings to indicate that the Engineer's design parameters have been met. These drawings shall include full scale details of the extrusions or pressings that the manufacturer intends to use, typical details of profiles and fixings, and details of sealing and glazing.

2. Shop Drawings

Upon approval of the manufacturer's design drawings fully detailed shop drawings shall be submitted to the Engineer for approval before fabrication commences. The drawings shall show elevations of all units, full-size sections of members, methods of installation and anchorage, locations of operating and other ironmongery, method and material of weather stripping, details of relationship with adjacent work, glazing methods, glass thickness, sealants, and provision of thermal movement. Adequate time in accordance with a program to be agreed by the Engineer shall be allowed between submission of drawings and commencement of manufacture, to take account of comments made and modification called for by the Engineer.

Approval of the shop drawings by the Engineer will not relieve the Contractor of responsibility for fulfilling all the requirements of the design drawings and the Specification.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

D. Submittals (Cont’d)

3. Sample Doors and windows

The Contractor shall supply for the Engineer's approval one complete sample window of each separate window type as will be determined by the Engineer. Each sample shall be completed with all its specified ironmongery and weather-stripping, and shall be glazed with the specified glass. Sample doors and windows shall be finished in accordance with the Specification. When the samples have been approved they shall be so marked and retained on site for reference.

4. Testing

At the Engineer's discretions a sample of any type of window he may require shall be submitted to an approved testing authority for tests to determine compliance with the performance requirements specified in B above. Should the window not meet these requirements the design shall be modified and further samples re-tested until they are met. Testing and any necessary re-testing shall be at no cost to the Contract. Samples which have satisfactorily passed tests shall be labeled accordingly.

5. Capillarity Data

The Contractor shall provide details of the methods by which capillarity will be controlled, so that the specific performance of the lights and doors is unaffected by this phenomenon.

6. Maintenance-free Period

The Contractor shall state the periods of maintenance-free life of all assemblies. Within the period of maintenance free life, the assembly shall perform at or above the levels specified elsewhere.

The Contractor shall give a recommended method of maintenance, after the expiration of the maintenance free life, in order to ensure that the components shall serve throughout the expected life of the building without loss of performance or appearance.

7. Window Data

The Contractor shall supply the Engineer with copies of all relevant manufacturer's data relating to the window.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

E. **Product Handling**

1. **Handling Generally**

   The doors and windows shall be carefully handled at all times at works, during transportation and storage and on site to prevent damage. Any damaged or defective items shall be removed from site and replaced at no additional cost.

   The requirements in respect of handling and temporary protection set out in Appendix G of BS 3987 shall be strictly complied with.

2. **Identification**

   The doors and windows shall be clearly identified in accordance with the window schedules. Identification shall be on a surface which shall not be visible in the finished work.

3. **Protection**

   The doors and windows shall be carefully packaged for transport and when in store shall be properly protected against damage and discoloration.

4. **Stacking**

   When in store the doors and windows shall be so stacked that they will not be subjected to undue stress or liable to distortion.

5. **Gaskets**

   Gaskets shall be suitably protected before and during delivery and during storage by packing in polythene bags to keep free from dust and dirt.

6. **Installation**

   The doors and windows shall be installed in the work only when all relevant conditions are suitable and when the general progress of the work is such that they will not be liable to undue damage.
F. **Materials**

1. **Aluminium Components**
   
   All aluminium alloy doors, windows and screens shall conform to the general requirements of BS 4873 and BS 1474, constructed from aluminium alloy extruded sections and couplings adaptable for single and double glazing, with silver anodized satin finish, supplied complete with frames, sub-frames, mullions, transoms, sills, louvres, doors and opening portions, as shown on the Drawings, and with manufacturer's matching ironmongery, glazing beads, gaskets, weather-strips, accessories and fixings. Unit may be pre-glazed or glazed on site.

   Man: Technal (France)

   Man: Heuke (Germany)

   Man: Kawneer Company Inc. (USA)

   Man: Schuco (Germany)

   or other approved equal.

   Refer to opening schedule for all types of windows.

   Aluminium shall be silver anodized satin finish aluminium profile to the approval of the Engineer.

   All extensions shall be of adequate thickness and strength, not only to meet the structural requirements, but also to eliminate any risk of distortion in the finished surfaces. The thickness of extension shall be sufficient to ensure their complete rigidity in the lengths required in the final installation.

   No web shall be less than 2.3mm in thickness.

   The aluminium sheet and plate shall be of suitable thickness and quality, suitably laminated where appropriate, to be retained in their position, without showing any deformation whatsoever under thermal influence, wind load and any other physical force. Deformation in excess of any tolerances under clause "Tolerances" will not be permitted.

2. **Bolts and Screws**

   All bolts and screws shall be of sufficient strength for their purpose. Visible screw or bolt heads will in general not be permitted. All bolts and screws in contact with aluminium shall be stainless steel.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

F. Materials (Cont'd)

3. Glass

The glass for opening and fixed parts of the door assemblies shall be in accordance with section 08800, Glazing. The Contractor shall ensure that the type and weight of glass is fully in accordance with regulations for the safe glazing of doors.

4. Weather-stripping

The weather-stripping shall be Neoprene gasket as manufactured strictly in accordance with the recommendations of the raw product manufacturer. It shall be entirely suitable for the performance required of it, easy to install and replace, shall not change its shape or become tacky as a result of aging or temperature variation.

Samples of gaskets shall be tested by approved testing firm in accordance with BS 4255.

The gaskets shall withstand water penetration and air penetration under the aforementioned wind load or wind load combined with driving rain and shall have "no leakage" as defined by BS 4315.

Gross leakage shall not be accepted. The clamping pressure shall be designed to be such strength as to allow for the effects of weather aging, normally anticipated to be approximately 25-30%. The reduction of clamping pressure i.e. stress relaxation shall be tested when exposed to a weatherometer test for at least 900 hours under alternating exposure to UVL, ozone and water. The clamping pressure after the weatherometer test shall be such as to provide for a safety factor normally used in structural members.

Gaskets shall be suitably protected before and during storage by packing in Polythene bags to keep free from dust and dirt.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

F. Materials (Cont’d)

5. Ironmongery

The window manufacturer shall be responsible for the selection of entirely suitable ironmongery which shall be subject to the approval of the Engineer.

All working parts shall be capable of withstanding at least 20,000 operations under the normal conditions of use without causing damage to any part of the window nor showing any applicable sign of wear or defect.

All materials shall be mutually compatible and able to withstand the effects of the climatic conditions of the site.

Metals shall comply with the requirements of sections 05010, Metal First Fixing Materials, and 05030 Metal Finishes. Ferrous metals shall be rustproofed by approved galvanic methods.

All doors, windows, screens, fixed panels, etc… shall be complete with all ironmongery as listed in the window schedules, including butts, locks, internal and external handles, kicking plates and push plates, flush bolts and door/window stops, concealed latches, etc…

The manufacturer shall make provision for and shall fit all items of ironmongery listed for the aluminium doors and the drawings or schedules of ironmongery.

6. Water Bar

All doors and windows shall have a water bar of aluminium same colour as profile set in mastic.

7. Fixing

Fixing devices, including nuts, bolts, washers, packing pieces, lugs etc. shall be in accordance with the approved shop drawings and shall be in materials conforming with section 05010, Metal First Fixing Materials.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

G. Workmanship

1. General

A high standard of finished workmanship and precision in assembly and fixing of components is required.

2. Dimensions

The overall size of each assembled unit shall be such that with a joint width between structure and unit of 6mm + 0mm - 3mm it shall fit into the actual opening as called for on the Engineer's drawings.

3. Tolerances

The surface flatness shall be established by use of a metal straight edge and a feeler gauge. Permitted deviations from the true shall not be in excess of +1.00mm non-accumulative. Permitted deviation of window width shall not be in excess of +0.5mm and permitted deviation in window height shall not be more than +1.0mm. Permitted variations in diagonals shall not exceed 1.0mm.

The required testing instruments and appliances shall be placed at the disposal of the Engineer in order to establish compliance.

All finished metal surfaces shall be flat and free from undulations or irregularities.

4. Manufacture

All joints between extrusions shall be carefully machined in the shop. Corners of hinged frames shall be mitred. Carry out all work necessary to ensure closely fitting, straight flush joints in all cases. After fitting together in the shop, all members shall be suitably marked on a concealed face so that they can later be identified on site and fixed in their correct relationship with each other.

Unless otherwise indicated, all aluminium units shall be manufactured with exposed grid members as shown on the drawings.

Arises where shown on drawings shall be sharp and precise and worked to a radius of no more than 1mm.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

G. Workmanship (Cont’d)

4. Manufacture (Cont’d)

Extrusions adjacent to, and in the same plane as, pressings shall be formed so as to have the same radius.

After fabrication all aluminium surfaces to be exposed to view shall be smooth and even in texture, free from superficial blemishes or damage of any kind and ready for the finish specified.

Fabricate all necessary weather stripping, flashings, supports and other component parts required for the complete installation.

5. Fixing

Completely concealed fixing methods shall be adopted as a principle throughout the work. If in isolated cases, face fixings are unavoidable, particular care shall be taken to locate these in unobtrusive positions, where heads of screws or bolts etc., shall be countersunk and finished to match the adjoining exposed aluminium surfaces. Details of all fixings to be subject to Engineer's approval at shop drawing stage.

All members at joints in external work shall be bedded in sealant.

The Contractor shall supply all fixing devices necessary. Due regard must be paid to the wind pressure to be expected and the method of fixing must meet the performance requirements previously specified.

The design shall take account of the building tolerances normally to be anticipated but ensure that the fixings are flexible to take up the tolerances to ensure accurate and straight positioning of the window.

The fixings to the concrete or concrete blocks of steel or other material, as agreed of steel or other material, as agreed by the Engineer conforming to all statutory requirements both as to strength and to type. They shall be fully protected to prevent corrosion and electrolysis. It shall be the Contractor's responsibility to allow for suitable materials.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT’D)

G. Workmanship (Cont’d)

5. Fixing (Cont’d)

In the case of a number units being installed to provide a continuous range, the jointing between adjoining units shall be such that no ingress of air or water shall take place.

All external jointing and screw fixings shall be coated to prevent the incursion of crevice corrosion. Face fixings shall be avoided.

The fixings shall be such that final positioning of the units may be adjusted to provide an accurate whole, truly vertical, in proper alignment and thoroughly secure.

6. Corrosive Action between Metals

No metals likely to cause galvanic or other corrosion must be placed or fixed in contact with the aluminium. Any other dissimilar materials are to be treated to avoid such action between metals.

7. Perimeter Sealing

The joint around the window frame on all sides shall be pointed in polysulphide or silicone sealant backed by joint filler.

8. Glazing

All doors and windows shall be glazed with glass conforming to the Specification in section 08800 and using glazing materials and methods therein specified.

9. Protection

The Contractor will be responsible for the adequate protection of his work until completed and handed over, and particular emphasis is placed upon the importance of avoiding any blemishes whatsoever on the finished aluminium faces.

Any protective tape or coating shall be removed with great care to avoid any damage whatsoever to the finished surfaces of the window.
ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

G. Workmanship (Cont'd)

10. Defective Work

The Contractor shall be required to replace at no extra cost any window which does not come up to the approved sample, or show signs of twisting, or any other defect. The cost shall not fall on the Contract for any fixing, decoration, transferring ironmongery or any other operation consequent upon the replacement of the window.

The installation shall be carried out with care to avoid damage to adjacent materials and surfaces.

11. Completion

On completion, all work shall be left clean and free from damage or defect, to the satisfaction of the Engineer.
WOOD DOORS (08210)

A. **Scope**

The work shall include the supply and fixing of wood doors in steel frames as indicated on the drawings.

The term “doors” in this section shall include doors, access panels and frames manufactured in wood.

B. **Performance and Standards**

1. **General**

   The doors shall comply generally with BS 459, Part 2 and BS 4787.

2. **Seasoning**

   All timber shall be well seasoned to a moisture content of approximately 10% plus or minus 2%.

3. **Specific Standards**

   Timber for cores and lipping shall be as defined in Appendix A of BS 1186, Part 1 as being suitable. Plywood shall be MR to BS 1455 paragraph 6, with facings Grade 2 in paragraph 3.

C. **Related Items**

   08110 Steel Doors
   08700 Ironmongery
   08800 Glazing
   09900 Painting

D. **Submittals**

1. **Sample Doors**

   Prior to general manufacture the Contractor shall provide for the approval of the Engineer one standard size single door completely finished.

   In addition to the above the Contractor shall supply one construction sample of each type of door as detailed on the drawings.

   When the samples have been approved they shall be so marked and retained on site for reference.
WOOD DOORS (08210) (CONT'D)

D. Submittals (Cont'd)

2. Ironmongery Samples

Samples of all approved ironmongery associated with wood doors shall be supplied by the Contractor to the door manufacturer before manufacture is commenced to ensure that proper provision is made for their incorporation, and full details are to be given as to which items apply to which door.

Particular attention is to be paid where concealed hinges are specified in order that the provision for fixing is adequate to withstand stresses set up by the operation of the hinges.

E. Product Handling

1. Handling Generally

The doors shall be carefully handled at all times at works, during transportation and storage and on site to prevent damage. Any damaged or defective item shall be removed and replaced at no additional cost.

2. Identification

The doors shall be clearly identified in accordance with the door schedules. Identification shall be on the top edge of the door.

3. Protection

The doors shall be carefully packaged for transport and when in store shall be properly protected against damage, discoloration, damp and insect attack.

4. Stacking

The doors shall be stacked when in store in such a manner that they will not be subjected to undue stress or liable to distortion, and they shall have adequate air circulation to all faces.

5. Installation

The doors shall not be installed within the building until the building is closed in.
WOOD DOORS (08210) (CONT'D)

F. **Materials**

1. **General**

All materials shall be in accordance with the requirement of BS 459 and BS 476 for Fire Rated Doors and access panels.

2. **Steel Frame**

For steel frames refer to Section 08110 - Steel Doors.

3. **Core Construction**

Flush doors: total thickness 45mm comprising 35mm thick tubular core construction with 5mm thick plywood on both faces as detailed on the drawings and as indicated in Bill Items.

The assembled panels shall be precision planed or sanded to a true level surface before faces are applied, and opposite faces shall be truly parallel.

4. **Fire Rated Glazed Doors**

Glazed doors shall comprise 45mm thick hardwood stiles to sizes indicated on schedules and Bill items, manufactured to required dimensions. Opposite panels shall be truly parallel. Provide grooves to house the specified glass and provide hardwood glazing beads of the same species of the door pane.

For double leaf panels provide vertical grooves for firm closing of both panels and provide continuous closing beads.

The assembled panels shall be precision planed or sanded to a true level surface before faces are applied, and opposite faces shall be truly parallel.

Glass shall be fire rated as specified in Section 08800.

5. **Fire Resisting Construction**

Door panels shall comprise extruded particle board or homogeneous mineral core with high density hardboard panels on both sides, total thickness 45mm, treated with flame retardant material. Materials and components to meet fire resistance requirements to Fire Authority when tested in accordance with the requirements of BS 476: Parts 20 to 23 inclusive and as appropriate.

Fire rated doors shall be labelled for the required fire rating. The Contractor shall provide certificate from the manufacturer for all fire rated doors and members.
WOOD DOORS (08210) (CONT'D)

F. Materials (Cont'd)

6. Provision of Ironmongery

Adequate provision shall be incorporated in the core to accept fixings for the specified ironmongery. The provision for concealed hinges, locks and latches shall be such that hinges, lock or latch case shall be entirely surrounded by solid material.

The provision for fixing hinges, door closers and pivots shall in all cases be solid timber, not chipboard or flaxboard.

7. Lipping

Doors shall be lipped on all vertical and top edges with hardwood lippings not less than 8mm thick. Single swing doors shall have a head lipping to the door and bottom lipping to the panel of adequate dimension to permit the rebate to be accommodated entirely in the lipping, and in any case not less than 25mm thick.

Lipping shall be suitable in all respects for the finish to be applied.

8. Glass

For glass refer to section 08800.

9. Paint Finish

The painting of doors is specified in section 09900.

10. Adhesives

All adhesives used in the manufacture of the doors shall be in all respects appropriate to the duty required of them and the best of their respective types. For Specification of adhesives refer to section 06400.
WOOD DOORS (08210) (CONT'D)

G. Workmanship

1. Dimensions

Doors and frames shall be of the dimensions and profiles shown on the drawings.

The Contractor shall be responsible for coordinating the size of doors with internal width and height of door frames so that the gap between door and frame shall be 2mm at jambs and head, the gap between leaves of double doors shall be 2mm and the clearance between bottom of door and finished floor 3mm.

2. Finish and General Quality

Doors and frames shall be finished flat and smooth, free from undulations, ripples, unevenness, face blistering, other defects and in particular any splitting of the face veneers: in achieving the required finish the manufacturer or the Contractor shall not sand or scrape the faces to the extent that the face veneer thickness is significantly reduced.

3. Painting

Workmanship shall be in full accordance with 09900 G; particular attention shall be paid to filling of the surface to eliminate grain, including board knife filling is required, to the complete satisfaction of the Engineer.

4. Hanging

The recesses for hinges shall be cut accurately to provide correct hanging without the introduction of packing.

5. Morticing for Ironmongery

The mortices shall be minimum size to accommodate the ironmongery.

Mortice for locks and latches shall be on the centre line of the thickness of the doors.

6. Defects

Doors shall be straight and true on all faces, opposite faces shall be parallel, and the doors shall be square. Doors shall be judged for general flatness and for squareness in accordance with BS 5277 and BS 5278 respectively.
WOOD DOORS (08210) (CONT'D)

G. Workmanship (Cont'd)

6. Defects (Cont'd)

The Contractor shall be required to replace at no extra cost any door which does not come up to the approved sample, or shows signs of warping, twisting, undulation, unevenness, face blistering or splitting or any other defects. The cost shall not fall on the Contract of any hanging, decoration, transferring ironmongery or any other operation consequent upon the replacement of the faulty door.

7. Glazing

For glazing of wood doors refer to section 08800.
OVERHEAD DOORS (08300)

A. **Scope**

The work of this section shall include, but not be limited to, the following:

1. Stainless steel overhead door electrically operated including guides, hardware, controls and accessories.
2. Brackets, fasteners, inserts and accessories required to support the work of this section.
3. Provide wiring from electric circuit disconnect to each unit operator to control station.

B. **Performance and Standards**

1. ANSI A216.1 - Sectional Overhead type Door (NAGDM 102).
3. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
4. NEMA ICS 2 (National Electrical Manufacturers Association) - Standards for Industrial Control Devices, Controllers and Assemblies.
5. NEMA MG1 (National Electrical Manufacturers Association) - Motors and Generators.
6. UL 325 (Underwriters Laboratories, Inc.) - Grille, Drapery, Gate, Louver, and Window Operators and Systems.
7. Protect all components and accessories from adverse weather conditions, especially against sea deterioration effects.
OVERHEAD DOORS (08300) (CONT'D)

C. **Related Items**

- 05010 Metal First Fixing Materials
- 05030 Metal Finishes
- 08120 Aluminium Doors and Windows

Division 16 Electrical

D. **System Description**


2. Loads: Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of wall as measured in accordance with ASTM E330.

E. **Design Requirements**

1. Operation: Design assembly, including operator, to operate for not less than 20,000 cycles and 10 cycles per day.

2. Emergency Egress: Provide mechanical release mechanism that allows unit to be opened for passage in emergency without requiring electricity.
   a. Release to be flush wall-mounted mechanism located remotely from grille to prevent operation from outside.
   b. Grille to automatically reset with return of handle to original position, without requiring resetting of limit switches.
   c. Provide interlock device to automatically prevent motor from operating when emergency release is engaged.

F. **Submittals**

1. Section 01300 - Submittal Procedures: Submittal procedures.

2. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

3. Product Data: Submit general construction, component connections and details, and electrical equipment.
OVERHEAD DOORS (08300) (CONT'D)

F. **Submittals (Cont'd)**

4. Samples: Submit two stile members, 300mm in size illustrating shape, color and finish texture.

5. Manufacturer's Installation Instructions: Submit installation sequence and procedures, adjustment and alignment procedures.

G. **Closeout Submittals**

1. Section 01700 - Execution Requirements: Closeout procedures.

2. Operation and Maintenance Data: Indicate lubrication requirements and frequency, and periodic adjustments required.

H. **Quality Assurance**

1. perform work in accordance with ANSI A216.1, application type residential.

2. Products Requiring Electrical Connection: Listed and classified by UL., or another testing firm acceptable to the authority having jurisdiction.

3. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

J. **Delivery, Storage and Handling**

1. Adequately protect and crate components against dirt, disfigurement and weather.

2. Store materials and accessories where designated. Contractor shall assume responsibility and security for materials and equipment. Protect during storage from detrimental conditions.

3. Protect the materials of this section after installation and protect installed work and materials of other trades.

4. In the event of damage, immediately make repairs and replacements necessary to the approval of Engineer.
OVERHEAD DOORS (08300) (CONT’D)

K. Materials

1. Stainless Steel Overhead Sectional Doors

Panels: Paneled stainless steel construction comprising 3mm thick double skin perforated panels; stainless steel stiles and rails with infill panels; stile and rail joints internally reinforced with stainless steel brackets; rebated weather joints at meeting rails.

Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

Lift Mechanism: Torsion spring on cross head shaft, with braided stainless steel lifting cables.

Sill Weatherstripping: Resilient rubber strip, one piece; fitted to bottom of door panel, full length contact.

Jamb Weatherstripping: Stainless steel section full height of jamb, fitted with resilient weather-stripping, placed in moderate contact with door panels.

Head Weatherstripping: EPDM rubber seal, one piece full length.

Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

Disconnect Switch: Factory mount disconnect switch in control panel.

Electric Operator: mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.
OVERHEAD DOORS (08300) (CONT’D)

L. Workmanship

1. Examination
   a. Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.
   b. Verify opening sizes, tolerances and conditions are acceptable.
   c. Verify that electric power is available and of the correct characteristics.

2. Preparation
   a. Examine the Contract Drawings and Specifications in order to insure the completeness of the work required under this Section.
   b. Verify measurements and dimensions at the job site and coordination and scheduling of the work of this Section with the work of related trades, with particular attention given to the installation of items embedded in concrete or built into masonry so as not to delay job progress.

3. Installation
   a. Install units and operating equipment including necessary hardware, jamb and head mold strips, anchors, inserts, hangers and supports in accordance with final shop drawings, manufacturer's instructions and as directed by the Engineer.
   b. Metal work built-in with concrete or masonry shall be formed for anchorage, or be provided with suitable anchors, expansion shields or anchoring device indicated on drawings. Such metal work shall be furnished in ample time for setting and securing in place.
   c. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
   d. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
   e. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
OVERHEAD DOORS (08300) (CONT'D)

L. Workmanship (Cont'd)

3. Installation (Cont'd)
   
f. Coordinate installation of electrical service with Division 16. Complete wiring from disconnect to unit components.
   
g. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
   
h. Install perimeter trim and closures.

4. Erection Tolerances
   
a. Maintain dimensional tolerances and alignment with adjacent Work.
   
b. Maximum Variation From Plumb: 1.5mm.
   
c. Maximum Variation From Level: 1.5mm.
   
d. Longitudinal or Diagonal Warp: Plus or minus 3mm per 3m straight edge.

5. Adjust and Clean
   
a. Upon completion, clean exposed surfaces and leave them in a condition entirely satisfactory to the Engineer.
   
b. Demonstrate operation of overhead doors and roller shutters to the Engineer and perform required adjustment.
   
c. Remove labels and visible markings.
IRONMONGERY (08700)

1 GENERAL

1.01 RELATED DOCUMENTS

A Drawings, schedule of hardware and general provisions of Contract, including General and Supplementary Conditions and relevant Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes hardware for steel doors, wood doors and steel access panels.

1. Furnish and deliver all finish hardware necessary for all doors and windows, also hardware as specified herein and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, special screws, bolts, special bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware.

2. All ironmongery shall be subject to the approval of the Engineer as regards quality, compliance with specified standards, functional performance and appropriateness, appearance in terms of finish and of compatibility with other items and availability for spares and replacements.

B Related Sections

1. Section 07900 - Joint Sealers.

2. Section 08110 - Steel Doors.

3. Section 08120 - Aluminium Doors and Windows

4. Section 08210 - Wood Doors.

5. Section 08300 - Overhead Doors
1.03 PERFORMANCE AND STANDARDS

1. Ironmongery to be used externally shall not deteriorate in the conditions of temperature/humidity that pertain to the area.

2. Standards
   
   a. BS EN 1303: 1998 Building Hardware Cylinders for Locks.
   
   b. BS 7352: 1990 Specification for strength and durability performance of metal hinges for side hung applications and dimensional requirements for template drilled hinges.
   
   c. BS 3621: 1980 Defines what constitutes a minimum standard of good security within a lock.
   
   d. BS 5872: 1980 Specifications for locks and latches for doors in buildings.
   
   e. BS EN 1125 Panic exit devices – requirements and test methods.
   
   f. BS 1154: 1997 Controlled door closing devices requirements and test methods.
   
   g. BS 476 Applicable to all fire rated building materials and structures. This test is a must whenever fire rated elements are requested.
   
   h. Fire Rating All hardware used on fire rated doors should comply to same standards of fire rating as doors and in specific of same fire rating hours.

1.04 SUBMITTALS

A General: Submit the following in accordance with Conditions of Contract and Specification sections.

B Catalog Cuts: Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
IRONMONGERY (08700) (CONT’D)

1.04 SUBMITTALS (CONT’D)

C Samples: Submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Samples are the property of the Employer.

D Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

E Shop drawing:

Indicate type, locations and mounting heights of each type of hardware as scheduled, catalogue cuts, electrical characteristics and connection requirements.

F Manufacturer’s Installation Instruction:

Submit special procedure, perimeter conditions, requiring special information.

1.05 QUALITY ASSURANCE

A Substitutions: Products are to be those specified to insure a uniform basis of acceptable materials. If proposing a substitute, submit that product data attached to product data for the specified item and indicate basis for substitution and savings to be made. Provide sample if requested. No other substitutions will be allowed. Certain products have been selected for their unique characteristics and particular project suitability.

1. Items specified as "no substitution" shall be provided exactly as listed.
2. Items listed with no substitute manufacturers have been requested by Employer/Engineer to match existing for continuity and/or future performance and maintenance standards or because there is no known equal product.
3. If no other products are listed in a category other than the one specified, then “no substitution” is implied.

B Qualification:

Company specialized in supplying commercial and institutional, type finishing door hardware with minimum 3 years experience. Suppliers should submit evidence of having executed at least two projects of similar nature and complexity, preferably in Lebanon.
1.05 QUALITY ASSURANCE (CONT'D)

C Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.

D Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by a testing and inspecting organization for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.06 DELIVERY, STORAGE, AND HANDLING

A Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B Each article of hardware shall be individually packaged in manufacturer's original container.

C The hardware, upon delivery, shall be jointly inventoried by representatives of both the Contractor and the Hardware Supplier. Any irregularities shall be noted at that time and future shortages shall be replaced at the expense of the Contractor.

D Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of the Work will not be delayed by hardware losses both before and after installation.

E Items damaged in shipment shall be replaced promptly and with proper material and paid for by whomever did the damage or caused the damage to occur.

F All the hardware shall be handled at this project in a manner to avoid damage, marring or scratching. Any irregularities that occur to the hardware after it has been delivered to the project shall be corrected, replaced or repaired by the Contractor at their expense. All hardware items shall be protected against malfunction due to paint, solvent, cleanser or any chemical agent.
IRONMONGERY (08700) (CONT'D)

1.06 DELIVERY, STORAGE, AND HANDLING (Cont'd)

G No direct shipments will be allowed unless approved in writing by the Contractor.

H Package hardware items individually with necessary fasteners, instructions and installation templates, special tools, if necessary; label and identify each package with door opening code to match hardware schedule.

J Coordination of work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.

1.07 WARRANTY

A Starting date for all warranty periods to be date of final handing over of the project.

B No liability is to be assumed where damage or faulty operation is due to improper usage or abuse.

C All hardware shall be guaranteed in writing for a period of (1) one year, except door closers devices and locks, which shall be guaranteed for (10) Ten years from manufacturer directly to the project owner (not from local supplier), commencing upon substantial performance and delivery of the work.

D The guarantees shall state that each item of hardware is guaranteed to be free from defects in the materials and operation for the stated period. Any defective item or items hardware shall be replaced immediately upon notification and proof of responsibility.

E Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer’s warranty, at no cost to the Employer.

1.08 MAINTENANCE

A Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Employer’s continued adjustment, maintenance, and removal and replacement of door hardware.
2 PRODUCTS

2.01 MANUFACTURERS:

A Approval of manufacturers other than those listed shall be in accordance with paragraph 1.05.A.

B Note that even though an acceptable substitute manufacturer may be listed, the product must provide all the functions and features of the specified product or it will not be approved.

C Scheduled Item: Acceptable Manufacturer:

1. Legge Locks
2. Briton closers and exit devices
3. Hager companies, or, A.F.L –UK for hinges and hardware
4. Steden or equivalent for architectural hardware
5. Glynn-Johnson or equivalent for architectural hardware
6. Ingersoll Rand companies for architectural hardware

2.02 MATERIALS

A General hardware requirements:

Where not specifically indicated, comply with applicable BS standards for each type of hardware required. Provide each type of hardware with accessories as required for the applications indicated and for complete, finished operational door.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently to avoid delay in work.

2. Reinforcement Units: Furnished by door and frame manufacturers; coordinated by hardware supplier.
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

A General hardware requirements: (Cont'd)

3. Fasteners: Furnished as recommended by hardware manufacturers to comply with application involved (steel, wood, ...), and as required to secure hardware.

4. Fire Rating: Provide hardware with fire rating label or certificate for type of application involved.

5. Electrical devices: make provision and coordinate requirements for electrical devices and connections for hardware.

6. Hand of door: The drawing show the direction of swinging or hand of each door leaf. Furnish each item of ironmongery for proper installation and operation of the door movement as shown.

7. Product finishes: the product finish to be as indicated in schedule as selected from manufacturers wide range of finishes.

B Hinges, Butts and pivots:

Provide hinges, Butts and pivots as follows:

Number of Hinges: Unless otherwise indicated, supplier should provide number of hinges per leaf to comply with his product fire rating test / certificate. A proof of such test should be presented.

As a general recommendation, three hinges should be provided for net leaf size of 2135mm X 915mm and a fourth hinge for bigger size.

1. Type of Hinges:

   a. Provide full mortise 5-knuckle, four ball bearing hinges standard weight, stainless steel in compliance with BS7352: 1990 class 9.

   b. Provide full mortise rising hinges, standard weight, stainless steel.

2. Hinge size: Unless otherwise indicated, or specified provide door hinge that comply with the requirements of and are sized in compliance with BS7352: 1990, being 4” x 3” x 3mm.
IRONMONGERY (08700) (CONT’D)

2 PRODUCTS (CONT’D)

2.02 MATERIALS (CONT’D)

B Hinges, Butts and pivots: (Cont’d)

3. Screws: Furnish Philips Flat – Head machine screws for installation of units, except furnish Philips flat-head all purpose or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

4. Hinge pins: Unless otherwise specified, provide hinge pins as follows:
   a. Interior doors: removable stainless steel pin
   b. Exterior doors: non-removable pin

5. Pivots: As recommended by manufacturer for size and weight and thickness of door, also check related drawings for further details.

C Locks and Latches:

1. Unless otherwise indicated or specified, provide locks and latches that comply with BS 5872: 1980.

2. Strikes: Provide manufactures standard strikes for each latch or lock bolt: with curved lip executed to protect frame, finish to match ironmongery sets.

3. Rabbeted doors: where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.

4. Provide 76mm Euro profile mortise Sashlock case, 57mm backset 57mm centers, brass follower to suit 8mm spindle, with adjustable tension spring to suit heavy unsprung or sprung lever furniture meeting BS5872 and fire rated to BS476, Stainless steel finish.

5. Provide 76mm Euro profile mortise dead lock case 57mm back set, to meet BS5872 and fire rated to BS 476, stainless steel finish.

6. Provide 76mm mortise bathroom lock, 57mm backset centers with reversible latch bolt, to suit 8mm spindle with adjustable tension spring, and dead bolt follower 5mm, stainless steel.
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

C Locks and Latches: (Cont'd)

7. Provide 76mm Euro profile mortise nightlatch lock case, 57mm backset, 57mm centers, brass follower to suit 8mm spindle, brass latchbolt, automatic locking action without key, when door is closed with latchbolt out, reversible latchbolt, cylinder and lever handle, to suit either hand of door.

8. Equip locks with euro profile double cylinder, 5 pins with length to match with the door thickness and the related installed accessories.

9. Equip locks with Euro-profile single cylinder, 5 pins with length to match with the door thickness and the related installed accessories.

10. Equip locks with Euro-profile single cylinder plus thumbturn, 5 pins with length to match with the door thickness and the related installed accessories.

11. All locks are to differ and are ensuite to grand master key, with 5 pin cylinders.

12. Provide 3 keys for each lock, finish as manufacturers standard unless otherwise indicated.

13. Provide thumbturn with indicator monitor and emergency release to comply with the provided bathroom lock, stainless steel finish.

14. Provide flat mortise latch with 87mm backset, with 8mm zinc die cast follower, suitable for use with sprung lever furniture with 8mm spindle.

15. Provide a special tool with 8mm spindle head that complies with the provided flat mortise latch to be used as a master handle that opens all access doors with flat mortise latch.
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

D Flush Bolts Door Silenceers and Dust proof strikes:

1. Flush Bolts:
   a. Lever action manual flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
   b. Automatic flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
   c. Lever action manual flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
   d. Automatic flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.

2. Door silencer: provide door silencer as manufacturer standard.

3. Dust proof strike: provides dust proof strikes for foot bolts except where special threshold construction requires specific type. Finish as requested by the Engineer unless otherwise indicated.

E Lever Handles:

1. Provide one set 19mm diameter 130mm length, 71mm projection lever handle on 50mm diameter rose manufactured from stainless steel.

2. Provide lever handle with half-spindle on one side to comply with the provided night latch lockset and to be 19mm diameter 130mm length 71mm projection on 50mm diameter rose, spring loaded, manufactured from stainless steel.
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

F Pull Handles / Push Plates/Midplates/Kickplates:

1. Pull Handles: Provide 19mm diameter 225mm C/C pull handle with roses. Manufactured from stainless steel sheet rolled. Mounting location as indicated on shop drawings.

2. Push Plate: Provide 350mm x150mm,1.2mm thick, stainless steel satin finish push plate. Round cornered with counter sunk screws. Mounting location as indicated on shop drawings.

3. Midplates: Provide 1.2mm thick, stainless steel satin finish with size to comply with the door width (DWx150mm) mid plate. Midplates to be round cornered with counter sunk screws. Mounting location as indicated on shop drawings.

4. Kickplates: Provide 1.2mm thick, stainless steel satin finish with size to comply with the door width (DWx200mm) kickplate. Kickplates to be round cornered with counter sunk screws. Mounting location as indicated on shop drawings.

G Exit Devices:

1. General: Unless otherwise indicated or specified, emergency exit devices shall comply with BS EN 1125 specification requirements for panic bolts and panic latches. And fire rated to BS 476.

   a. Cross bar exit device for single leaf with dual profile cylinder mortise panic night latch and outside trim. Location as indicated on hardware schedule.

   b. Touch bar panic exit device for single leaf with dual profile cylinder mortise panic night latch and outside trim. Location as indicated on hardware schedule.

   c. Cross bar Vertical rod panic bolt to be installed on one leaf of a double door with outside trim location as indicated on hardware schedule.

2. Panic Device Trim: Provide outside access device with lever handle and europrofile cylinder to match with master key program. Finish shall be subject to the approved of the “engineer”.
IRONMONGERY (08700) (CONT’D)

2 PRODUCTS (CONT’D)

2.02 MATERIALS (CONT’D)

H Door Closer:

1. General: Unless otherwise indicated or specified, closers and door control devices shall comply with the applicable requirements of BS EN 1154: 1997 and finish shall be subject to the approval of the engineer.

2. Size of units: Except as otherwise specifically indicated, comply with manufacturer’s recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use. Provide arm to comply with the application involved. All door closers to comply with the fire rating requirements.

3. Specification of Unit: Door closer with stainless steel cover which feature a cast iron body with a hardened steel rack and pinion incorporating needle roller bearing housed beneath a precision zinc die cast cover. And to have the following.

   a. Template and quick-fit back plate
   b. 2-6 adjustable strength size or size to suit door weight and dimensions
   c. Non-handed.
   d. 180 deg. Opening/controlled closing
   e. Separate adjustment of latch action & closing speed.
   f. Temperature compensation –15deg C to +40deg C.
   g. Adjustable backcheck
   h. Adjustable delayed action.
   i. Matching arms.
   j. Quick release arm assembly
   k. Pre assembled arm assembly
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

H Door Closer: (Cont'd)

3. (Cont'd)

l. Tripacked for applications

   1. Regular, closer is fitted to the pull (hinge knuckle) face of the door.

   2. Transom mounted, closer is fitted to the transom on push face of the door. Bracket fitted to the door face.

   3. Parallel arm, closer is fitted to the push (opposite to hinge knuckle) face of the door. Bracket is fitted to underside of head frame.

m. Closer Cover design and finish is to be approved by the engineer in charge.

I Door selector (door coordinator): Provide door selector to comply with Application involved and the BS requirements for fire rating and performance. Type and finish to be approved by the Engineer in charge.

J Door Stop:

1. General: Unless otherwise indicated or specified door stops shall comply with the latest British standard applicable.

2. Door Stop Units shall include but shall not be limited to door ironmongery as follows:

   a. Dome Stop

   b. Wall Bumpers

   c. Security Door Stop
IRONMONGERY (08700) (CONT’D)

2 PRODUCTS (CONT’D)

2.02 MATERIALS (CONT’D)

K Double acting floor spring:

1. General: Unless otherwise indicated or specified, double acting floor springs shall comply with the applicable requirements of the European standards for controlled door closing devices BS EN 1154:1997. Finish shall be subject to the approval of the engineer in charge.

2. Double acting floor spring for NON FIRE RATED DOORS: Provide mechanical hold open double acting floor spring with the following features:

   a. Size of unit, unless otherwise specifically indicated, comply with the manufacturer floor spring unit selection chart.

   b. Hydraulic door speed control from 170 deg.

   c. Latch action control from 10 deg.

   d. Mechanical backcheck.

   e. Pressure relief valve to protect the unit against any closing abuse.

   f. Mechanical hold open, to hold the door in the open position until manually released Fixed hold open function 90 deg or 105 deg. Which should be specified when ordering.

3. Double acting floor spring for FIRE RATED DOORS: Provide Electromagnetic hold open/release function double acting floor spring An electromagnetic hold open device which is normally interfaced with a detector/alarm system, holding open at an angle between 80 deg. & 170 deg. When the device is energized. A fail safe unit which operates when:

   a. The alarm is activated either manually or by smoke, or by heat sensitive device.

   b. There is a power failure (or any interruption to the power supply) in which case the door will be released to close automatically.
IRONMONGERY (08700) (CONT'D)

2 PRODUCTS (CONT'D)

2.02 MATERIALS (CONT'D)

K Double acting floor spring; (Cont'd)

3. (Cont'd)

c. The door is manually pulled from the hold open position allowing the floor spring to close the door.

The floor spring top plates finish to be selected by the engineer in charge.

L Accessories:

- Provide Escutcheon for euro profile cylinder finish to match ironmongery sets.

- Provide room identification signs to comply with the application involved, shape and finish as approved by the Engineer in charge.

- Provide Hat and Coat Hook buffered, finish to match ironmongery sets.

- Provide: Rubber door silencer manufacturer standard type.

- Provide rubber seals for groove type frames manufacturer standard type.

3 EXECUTION

3.01 EXAMINATION

A Prior to installation of any hardware, examine all doors, frames, walls and related items for conditions that would prevent proper installation of finish hardware. Correct all defects prior to proceeding with installation.

B Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

C Verify electric power is available to power operated devices and is of correct characteristics.
3.02 INSTALLATION

A All hardware will be installed by qualified tradesmen, skilled in the application of commercial grade hardware. For technical assistance if necessary, installers may contact the manufacturer’s rep for the item in question, as listed in the hardware schedule.

B Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

C Mount ironmongery units at heights as specifically directed by the engineer. Install each ironmongery item in compliance with the manufacturers instruction and recommendations whenever cutting and fitting is required to install ironmongery onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protection. Do not install surface mounted items until finishes have been complete the substrates.

D Set Units plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Drill and countersink units which are factory prepared for anchorage fasteners, space fasteners and anchors in accordance with manufacturer’s instructions or as directed.

3.03 Adjust and Clean:

A Adjust and check each operating item of ironmongery and each door to ensure proper operation or function of energy unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B Final Adjustment: where ever ironmongery installation is made more than one month prior to acceptance of a space or area, return to the work during the week prior to acceptance and make final check and adjustment of all ironmongery items in such space or area. Clean operating items as necessary to restore proper function and finish ironmongery and doors.

3.04 SCHEDULES

Refer to schedules of hardware.
GLAZING (08800)

A. **Scope**

1. This Section describes the glazing of doors, windows, entrances, shop fronts, curtain walls, mirrors, balustrades, floor and wall paneling.

B. **Performance Standards**

1. All glass shall be in accordance with BS952. Glazing shall comply fully with the recommendations of BS 6262, especially in the selection of appropriate type and thickness of glass having regard to wind load safety under impact.

   Toughened or other safety glass shall be used where shown on the drawings or where necessary to comply with BS 6262, Clauses 4.7 and 5.7, and BS 6026, Clause 4.

2. The Contractor shall ensure that all glazed-in materials are of adequate thickness, quality an strength to meet the required standards for wind loading.

   Exposure up to 1250 N/m² shall be allowed for.

   The glass shall not fail under thermal stress or thermal shock caused by part of the glazing being exposed to the sun while another part lies in shadow. This applies in particular to double-glazing units.

3. Unless otherwise directed, all situations where the presence of transparent glass may not be evident, or where the injury or risk of breakage is to be assumed, and in order to avoid the risk of human impact with the glazing, stainless steel discs or other configurations approved by the Engineer shall be adhered to indicate the presence of glass.

C. **Related Items**

07800 Canopy
08120 Aluminium Doors and Windows
08210 Wood Doors
08930 Glazed Aluminium Curtain Walls
GLAZING (08800) (CONT'D)

D. Submittals

1. Samples of Glass

Samples 300mm square of each type of glass specified shall be submitted for approval of colour, texture and pattern only. Compliance with other requirements is the exclusive responsibility of the Contractor.

2. Samples of Glazing Materials

Samples 300mm long of each type of glazing gasket or sealant shall be submitted for approval.

3. Manufacturer's Data

The Contractor shall submit manufacturer's specifications, data and installation instructions, including certified test results where available, for all glass and glazing materials.

E. Product Handling

1. Delivery

All glass shall be delivered to site in proper containers with marker's name, guarantee, type of glass and thickness or weight of glass attached to the outside of the containers.

Safety glass shall be visibly marked to indicate the tested level of impact resistance.

2. Storage on Site

Glass on site shall be stored in a dry, sheltered location, in felt-lined racks with back support in a near vertical position, secured against wind loading. Stacked glass in opened cases containing glass must not be subjected to direct sunlight which can cause build-up in the stack resulting in thermal stress breakage.

Stacks shall not be more than 500mm deep.

3. Protection

The glass shall be protected at all times from edge damage during handling and installation.
GLAZING (08800) (CONT'D)

F. Materials

1. General

Glass shall be of uniform thickness, free from waviness, air bubbles and all other defects. It shall be in conformity with BS 952.

Striations, where visible, shall run horizontally.

Glass thicknesses, shape and quality shall be as described in the Bills of Quantities.

Glass shall be manufactured by "Saint Gobin", "L.O.F. Ford", "Saudi Glass", "K.Lite" or approved equal.

2. Clear Float Glass

Clear float glass shall be 6mm thick for aluminium glass louver units, as shown on drawings, ordinary Glazing Quality and shall provide a clear, undistorted vision and reflection.

3. Laminated Glass

The laminated glass shall be 8mm thick clear acid treated for wood doors, 8mm thick light blue tint glass for aluminium units, shop fronts and entrances, 16mm thick clear glass for canopy and 10mm thick for paneling between elevators similar to elevator doors and 18mm thick clear for balustrades. The laminated glass shall be two or more panes of glass bonded together and alternated with plastic interlayer(s).

4. Fire Rated Glass

All fire rated glass shall be ¼" thick UL/WHI listed glass and permanently labeled with testing laboratory. Fire rating shall be in terms on integrity only.

All fire rated glass shall be factory cut to size to fit the vision frame and shipped with the vision frame.

5. Curved Glass

The Contractor shall provide and install curved glass as indicated on the drawings in the Bills of Quantities.
GLAZING (08800) (CONT'D)

F. Materials (Cont'd)

6. Double Glazing

Double glass shall be two panes of glass hermetically sealed at their periphery of either 6mm thick clear inner pane with low E / 12mm void / 6mm thick tempered light blue tint outer pane; or 6mm thick clear inner pane with low E / 10mm void / 8mm thick laminated screen printed light blue tint outer pane as shown on the drawings.

7. Mirror Glass

This shall be 6mm polished plate with an even deposit of silver or bronze over the entire surface on one side. The silver or bronze is to be protected by electro-plating with copper, followed by the application of an approved protective lead finish.

8. Glass Flooring

Shall be four sided 18mm thick laminated comprising two structural glass panels and one functional glass panel with screen printed inlay between the structural and functional panels.

Strips in interior passage shall be 30mm thick sand blasted triplex glass.

9. Miscellaneous Glazing Materials

a. Setting Blocks

3mm thick x 75mm long x width to suit rebate details, neoprene or P.V.C. with a Shore a hardness of approximately 70-80.

b. Location pieces and distance pieces

Neoprene or other approved resilient material of not more than 25-30 Shore a hardness.

c. Glazing Compound

Shall be from an approved manufacturer.

d. Gaskets

Gaskets shall be pre-formed sections providing a continuous surround for the glass and a weather tight seal when compressed, and shall be manufactured from Neoprene from an approved supplier.
GLAZING (08800) (CONT’D)

F. Materials (Cont'd)

9. Miscellaneous Glazing Materials (Cont'd)

   e. Wash Leather

      Wash leathers for the use of fixed glazing in banisters, etc. where not under constant vibration shall be synthetic wash leather from an approved supplier.

   f. Glazing Beads

      Glazing beads shall be secured with self-tapping screws at distances of not more than 300mm unless fixed by other approved methods.

G. Workmanship

1. General

      Watertight and airtight installation of each piece of glass is required, and the glazing must withstand temperature changes, wind loading, impact loading in the case of doors and opening lights, without failure of glass or glazing materials. The recommendations of glass and glassing compound manufacturers shall be followed.

2. Preparation

      Rebates and beads must be clean immediately before glazing. Primer of sealer shall be applied to the timber surfaced in contact with glazing compound if so recommended by the compound manufacturer.

3. Measurement and Cutting

      The Contractor shall take all necessary site measurements. Safety glass and sealed double-glazing units shall be manufactured to the required size and shall not be cut, nipped or abraded on site. All glass panels shall be cut or manufactured to allow a 2mm gap all round each opening to be glazed, or as otherwise specified by the manufacturer and agreed by the Engineer.

4. Dimensional Tolerances

      Glazed units shall be square and the maximum variation shall be plus or minus permissible tolerance for glass shall be plus or minus 3mm out of square and plus or minus 0.5mm in thickness.
GLAZING (08800) (CONT'D)

G. Workmanship (Cont'd)

5. Installation

Comply with the requirements and recommendations of BS 6262. All glass panes shall be set on setting blocks, centralized by means of location pieces between the edge of the glass and the face of the opening, and spaced equally between the back of the rebate and the bead by distance pieces. The spaced around the edge of the glass shall be completely filled with glazing compound. Tool exposed surfaces of the glazing compound in such a way as to shed water away from the glass, leaving clear smooth surfaces with any excess compound trimmed away.

Securely fix beads on a thin bed of glazing compound with cups and screws as specified for wood doors and windows, or in accordance with manufacture's details for aluminium doors and windows. Eliminate glazing compound stains and discolourations from glass and all adjacent surfaces.

Glazing materials shall be used in accordance with the recommendations of the manufacturer.

6. Mirror Fixing

Mirrors shall be fixed to wall tiling using adjustable plastic clips screwed to walls and fastened to mirrors with adjustable washers.

7. Protection and Cleaning

Protect glass from breakage after installation and indicate presence of glass by a form of taping or marking which will leave no remark or stain after eventual removal. Before buildings are handed over remove and replace any broken, damaged, stained or marked glass, however caused.

Wash and polish both faces of glass immediately before hand-over.
GLAZED ALUMINIUM CURTAIN WALLS (08930)

A. **Scope**

This Section specifies all glazed curtain walling devices as detailed on the drawings, and as indicated in the Bills of Quantities constructed in aluminium.

B. **Performance and Standards**

1. **General**
   
   a. All constituent materials and component parts shall be of the best of their respective kinds, shall withstand the effects of solar radiation, heat, rapid temperature change, humidity, and rain without distortion or material breakdown.

   Complete assemblies shall function efficiency in all conditions in accordance with the design intent.

   b. The finishes of all materials shall be in accordance with appropriate and relevant clauses.

   c. All materials used in the manufacture of curtain walls shall comply with all relevant current British Standards.

2. **Performance**

   a. Refer to section 08120 Aluminium Doors and Windows; B3

C. **Related Items**

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal First Fixing Materials</td>
<td>05010</td>
</tr>
<tr>
<td>Metal Finishes</td>
<td>05030</td>
</tr>
<tr>
<td>Aluminium Doors and Windows</td>
<td>08120</td>
</tr>
<tr>
<td>Ironmongery</td>
<td>08700</td>
</tr>
<tr>
<td>Glazing</td>
<td>08800</td>
</tr>
<tr>
<td>Window Washing Systems</td>
<td>10700</td>
</tr>
</tbody>
</table>
GLAZED ALUMINIUM CURTAIN WALLS (08930) (CONT'D)

D. Submittals

1. Samples of curtain walls

The Contractor shall supply for the Engineer's approval such samples of the curtain walls materials as the Engineer may require. Each sample shall be complete with fixing straps, building-in lugs, bolts, butts, hook arms and keeps, and all other fixings as shown on the drawings.

When approved the samples shall be retained on site for reference.

2. Aluminium Samples

The requirements of Section 08120 Aluminium Doors and Windows as regards aluminium samples shall apply.

E. Product Handling

The requirements of Sections 08120, Aluminium Doors and Windows shall apply.

F. Materials

1. General

The curtain walling system shall be as manufactured by "Technal (France)", "Schuco (Germany)", "Heuke (Germany)", "Kawneer (USA)" or approved equivalent.

The construction of the curtain walling shall include the supply, delivery and installation of items hereinafter.

2. Aluminium

Frames and Sections constructed in aluminium shall be to the specification in Section 08120.
GLAZED ALUMINIUM CURTAIN WALLS (08930) (CONT’D)

F. Materials (Cont’d)

3. Ironmongery and Fittings

All fixing straps, building inlugs, bolts, butts, strap hinges, pivot pins hook arms and keeps, brackets, angles and all other fixing devices shown on the drawings shall conform to the requirements of Section 05010, Metal First Fixing Materials and Section 05500, Metal Fabrications.

The items shall be to the dimensions and forms shown on the drawings, or where not specifically described on the drawings they shall be at the Contractor's discretion subject to sample approval and suitability for the duty to be performed.

4. Glass

Refer to Glazing section 08800; F.

5. Miscellaneous

a. Water and air tight finish including the expandable joint kit between construction and the other building elements.

b. The sandwich elements including insulation fill and painted gypsum board between construction and the other building elements

c. Aluminium sills

d. Sheet finishing

e. EPDM gaskets

f. The drainage system
GLAZED ALUMINIUM CURTAIN WALLS (08930) (CONT’D)

G. Workmanship

1. General

Workmanship generally shall be in all respects in accordance with the relevant clauses in Section 08120 Aluminium Doors and Windows.

2. Installation

The curtain wall shall be securely fixed with all bolts tightened to ensure that fixings of not progressively loosen in the wind conditions that can be anticipated. The Contractor shall determine what may be required in the way of washers, sprung or otherwise, to enhance the rigidity of the assembly.

Special care shall be taken to ensure that curtain walls are fixed level and truly vertical as shown on the drawings.

3. Glazing

All curtain walls shall be glazed with glass confirming to the Specification in Section 08800 and using glazing materials and methods therein specified.

4. Protection

The Contractor will be responsible for the adequate protection of his work until completed and handover, and particular emphasis is placed upon the importance of avoiding any blemishes whatsoever on the finished aluminium faces.

Any protective tape or coating shall be removed with great care to avoid any damage whatsoever to the finished surfaces of the curtain walls.

5. Completion

On completion, all work shall be left clean and free from damage or defect, to the satisfaction of the Engineer.
DIVISION 9

FINISHES

CEILING SUSPENSION SYSTEMS (09120)

A. **Scope**

1. The work shall consist of the supply and fixing of suspension systems appropriate in all respects to each of the types of suspended ceiling employed in the Contract.

B. **Performance and Standards**

1. **Adequacy of Support**
   
   a. The suspension systems shall be designed to provide substantial support for the ceiling finishes and associated light fittings, grilles, margins and any item forming part of the finished ceilings, in order that the soffit of the ceiling remains permanently true and level within specified tolerances.
   
   b. The method of fixing the suspension system to the building structure shall be flexible type agreed with the Engineer and shall be completely secure.
   
   c. Where so required the system shall be sufficiently robust to provide fixings and support for mechanical and electrical services suspended within the ceiling voids, and shall be designed and set out to facilitate the integration of such services.
   
   d. Where partitions terminate at the suspended ceiling level and are not otherwise restrained the suspension system shall be sufficiently robust and suitably braced to provide rigid support to the tops of the partitions.

   Wherever possible the bracing shall be two directional forming a 'V' in elevation and 'X' in plan, with 45 deg. angles.

2. **Rust and Corrosion Resistance**

   All members shall not rust and shall not suffer any form of corrosion.
CEILING SUSPENSION SYSTEMS (09120) (CONT'D)

B. Performance and Standards (Cont'd)

3. Thermal Movement

The system shall make allowance for thermal movement of the ceiling material due to temperature fluctuations deriving from heat emitted by light fittings or from any other cause.

4. Standards

All materials shall conform to relevant British Standards, in particular to those Standards, where appropriate, listed in sections 05010, Metal First Fixing Materials, and 05030, Metal Finishes. BS CP 290.

C. Related Items

05010 Metal First Fixing Materials
05030 Metal Finishes
09515 Suspended Ceiling Systems

D. Submittals

1. Data

The Contractor shall supply the Engineer with duplicate copies of manufacturer's published data, instructions for fixing and assembly and any other relevant information.

2. Samples

The Contractor shall provide samples of components and materials to be used in the work.

A mock-up of size as directed by the Engineer shall be erected of each type of ceiling, including light fittings, diffusers, etc., as described elsewhere. The mock-ups shall comprehensively include the suspension system, which shall be approved by the Engineer before the commencement of the work in general.

3. Shop Drawings

The Contractor shall submit requisite copies of shop drawings showing all necessary details prior to the commencement of work and shall obtain Engineer's approval.
CEILING SUSPENSION SYSTEMS (09120) (CONT'D)

E. **Product Handling**

1. All materials shall be handled at all times as to prevent damage. Any damaged materials shall be replaced at no additional charge.

F. **Materials**

1. **Note:** The Contractor is referred also to the following sections which include relevant suspension systems:

   Section 09515  Suspended Ceiling Systems

2. **Materials Generally**

   Suspension systems shall generally be of hot dip galvanized steel members comprising all hangers, runners, trimmers, bearers, clips, tie wires, bolts and screws necessary to install the ceilings rigidly and to a true and level finish. The use of timber is to be avoided where possible, but if necessary, shall be carcassing grade softwood free from defects, pressure impregnated, rendered fully resistant to termite attack, and of appropriate moisture content.

   All cut ends and any damage to protective coatings shall be made good before plastering commences, to ensure that no subsequent staining occurs on adjacent finishes and that no corrosion will occur in the ceiling void on any ceiling components. Should any such defects occur before the end of Defects Liability period, the Contractor will be required, at his own expense, to cut out and make good to the satisfaction of the Engineer, including redecoration of the complete ceiling involved.

   In spaces of particularly high humidity, (80 deg. humidity) the members of the suspension system shall be aluminium alloy in lieu of steel.

   Wherever dissimilar metals are in contact with each other precautions shall be taken to prevent corrosion from electrolytic action.

3. **Bolts and Screws**

   All bolts and screws, washers and nuts shall be sherardized or otherwise protected to the Engineer's satisfaction, and shall be of sufficient strength for their purpose.
CEILING SUSPENSION SYSTEMS (09120) (CONT'D)

F. Materials (Cont'd)

4. Tying Wire

All tying wire shall be galvanized soft wire conforming with BS 443 and shall be 1.2mm (for securing expanded metal) and 3mm (for securing ceiling runners to bearer channel).

5. Expanded Metal Beads

At all perimeters and openings in expanded metal ceilings, angle bead, or stop beads shall be to the approval of the Engineer.

All metal beads shall comply with BS 1246: 1959.

6. Hangers, Bearers, Runners, etc.

The principal components of the suspension system shall be in accordance with the drawings, or approved manufacturer's standard components, in mild steel, (or aluminium: see F2 above).

G. Workmanship

1. General

Methods of erection and all workmanship shall be in accordance with the recommendations of the manufacturer of the ceiling system, and with the relevant clauses of BS CP 290.

2. Setting Out

The contractor shall allow for all secondary systems of suspension as may be necessary to bridge ducts or other services to maintain the necessary fixing centres on the system. Before starting work ensure that light fittings, grilles, etc., are in correct positions relative to ceiling grid. Ensure that all trades use common setting out points. Ensure that the ceiling is properly related to each grid line of the building, and that there is no accumulative creep over the length or width of any ceiling. The ceilings are part of a modular co-ordination system joint lines will dictate locations for pre manufactured partitions, panels, screens, etc., which will be fixed later. No cutting or making up will be allowed.
PORTLAND CEMENT PLASTER (09220)

A. **Scope**

This section specifies internal plaster of cement and sand to existing and new blockwall or concrete surfaces.

B. **Performance and Standards**

1. The plaster shall have complete adhesion to the wall and shall not crack or craze.

2. Cement BS 12 or ASTM C 150 Type I
   Sand BS 1199. Table 1.

C. **Related Items**

09225 External Render
09900 Painting

D. **Submittals**

1. **Samples of Materials**

   The Contractor shall supply a sample of the sand for plastering for approval by the Engineer, and such samples as the Engineer might require of miscellaneous plastering materials such as plaster stops and casing beads.

2. **Sample of Workmanship**

   The Contractor shall carry out the plastering of one wall as a sample of workmanship and finish. The generality of the work shall not proceed until the sample is approved by the Engineer.

E. **Product Handling**

Cement shall be delivered in the manufacturer's sealed bags or other approved container, and shall be stored off the ground, in a dry shed. Sand shall be kept free from organic or any other contaminated substance.
PORTLAND CEMENT PLASTER (09220) (CONT'D)

F. Materials

1. Cement

Cement shall be Portland Cement to BS 12 or ASTM C 150 Type I.

2. Sand

Sand shall be clean, washed sharp sand to BS 1199, Table 1.

3. Lime

Lime shall be hydrated conforming to ASTM C-207, latest edition and shall be at least 92% hydrated lime putty shall be stiff mixture of lime and water, kept moist until used.

4. Angle Beads, Stop Beads, etc.

All such plastering accessories shall be standard galvanized mild steel products.

5. Mix

The mix shall be 1 part cement to three parts sand by volume, or as otherwise agreed with the Engineer. Plasticiser shall only be used with the approval of the Engineer.

6. Accessories

Angle beads shall be as manufactured by "Cantic", "Expamet" or approved equal to the approval of the Engineer.

Stop beads shall be to the approval of the Engineer.

The above accessories are from 0.56 tight coat galvanized sheet, synthetic coated, with white PVC protective nosing.

Exposed plaster stops shall be aluminium.
PORTLAND CEMENT PLASTER (09220) (CONT'D)

F. Materials (Cont'd)

7. Metal Lath

Expanded metal lath diamond type shall be used at joints of dissimilar materials in order to reinforce against cracks especially at concrete/blockwork intersection and shall extend 100mm at each side.

Expanded metal lath shall be manufactured to BS 1369: Part 1:1987. The galvanized steel used in the manufacture of metal lath shall be in accordance with BS EN10142: 1991 of Fe P02G quality coating type Z275.

Sheet lath mesh shall be minimum 9mm diamond pattern, weight 1.63kg/m², galvanized.

G. Workmanship

1. Preparation of Substrate

Ensure that all chases or other apertures have been cut. Ensure that the substrate surface is free from dust, oil, etc. Ensure adequate key for plaster, if necessary by hacking the surface or applying a coat of approved bonding agent. Rake out joints in blockwork.

2. Trims and Joints

Fix beads, stops, angle beads, etc., plumb, square and true to line and level, as indicated on drawings.

3. Plaster

Unless single coat plastering is required or agreed by the Engineer apply plaster in two coats to a total thickness of 20mm.

Thickness and finish of plaster shall be as stated in the Bills of Quantities.

Apply spatter dash coat to all concrete and blockwork surfaces and allow to dry thoroughly.

Apply first coat and cross-scratch surface of first coat to provide key for second coat.
PORTLAND CEMENT PLASTER (09220) (CONT'D)

G. Workmanship (Cont'd)

3. Plaster (Cont'd)

Allow the first coat to dry thoroughly before applying second coat.

Dub out as necessary to correct inaccuracies; dubbing out shall not exceed 10mm.

Apply second coat and finish with a wood float.

Each coat shall be applied firmly to achieve good adhesion, in one continuous operation. Finish the surface to a true plane to the correct line and level and plumb, with all angles and corners to a right angle unless otherwise shown on the drawings.

Wire mesh metal lathing shall be installed at all junctions of dissimilar materials.

Plaster in water tanks shall be mixed with waterproofing additive as specified in section 09225 (External Render).
EXTERNAL RENDER (09225)

A. **Scope**

This section includes but not limited to:

1. External render of cement and sand with waterproofing additive to blockwork and concrete surfaces.

B. **Performance and Standards**

1. The work is to be carried out in compliance with all relevant British Standards, in particular with BS 5262.
   
   The render shall have complete adhesion to its background and shall not crack or craze.

2. Cement BS 12 or ASTM C 150 Type I.
   Sand BS 1199, Table 1.

C. **Related Items**

09220 Portland Cement Plaster
09900 Painting

D. **Submittals**

1. **Samples**

   The Contractor shall supply a sample of the sand for render for approval by the Engineer, and sample of expanded metal lathing external angle bead and external stop beads.

2. **Samples of Workmanship**

   The Contractor shall carry out a sample area of render on blockwork and a sample area of render on metal lathing. The generality of the work shall not proceed until these samples are approved by the Engineer.
EXTERNAL RENDER (09225) (CONT'D)

E. **Product Handling**

1. Cement shall be delivered in manufacturer's sealed bags or other approved container, and shall be stored off the ground in a dry shed.

2. Sand shall be kept free from any contaminated substance.

F. **Materials**

1. **Cement**
   
   Cement shall be Portland Cement to BS 12 or ASTM C 150 Type I.

2. **Sand**
   
   Sand shall be clean, washed sharp and to BS 1199, Table 1.

3. **Bonding Agent**
   
   The bonding agent for use on concrete and blockwork shall be epoxy adhesive bonding agent.

4. **Metal Lathing**
   
   Refer to Section 09220, para. F.

5. **Rendering Accessories**
   
   External angle beads shall be as manufactured by "Cantie", "Expamet" or approved equal, to the approval of the Engineer.

   External stop bead shall be to the approval of the Engineer.

   The above accessories are made from 0.56 tight coat galvanized sheet, synthetic coated, with white PVC protective nosing.

   Angle beads shall be used for external rendering behind wet fixed stone cladding.

6. **Waterproofing Additive**
   
   Waterproofing additive materials shall be a formulation of acrylic polymer and modifiers in a water based emulsion designed for use as admixture and shall be approved by the Engineer.
EXTERNAL RENDER (09225) (CONT'D)

G. Workmanship

1. Preparation of Background

Ensure that backgrounds are adequately true and level to achieve specified tolerances, free from contamination and loose areas, and adequately prepared to give a good bond.

2. Trims and Joints

Fix with mortar dabs at no more than 600mm centres all stops, angle beads etc., plumb, square and true to line and level as indicated on drawings.

3. Tolerances

The maximum gap between an 1800mm straight edge and the render at any point on the surface shall be 3mm.

4. Render on Blockwork and Concrete

a. Spatter Dash

Apply spatter dash cement and sand coat to all concrete and blockwork surfaces.

b. Render Coats

Unless single coat rendering is required or agreed by the Engineer, apply render in two coats, 20mm overall thickness, each coat to a uniform thickness not less than 10mm.

Thickness and finish of render shall be as indicated in Bill Items.

Apply each coat firmly to achieve good adhesion and in one continuous operation between angles and joints. Rule to an even surface and cross scratch first coat to provide a key for the second coat.

The top coat shall be finished with a wood float to give an even texture. Do not overwork surface or use a steel trowel to finish. Do not apply water to final coat while working up. Do not draw excessive laitance to the surface.

Rendering to face of shotcrete in basement structure shall be in multi-coats to achieve vertical and good base for applying the waterproofing system.
EXTERNAL RENDER (09225) (CONT'D)

G. Workmanship (Cont'd)

4. Render on Blockwork and Concrete (Cont'd)
   
c. Dubbing Out

   If necessary to correct inaccuracies, dub out in thicknesses not exceeding 10mm in the same mix as the render coats. Cross scratch each dubbing out coat immediately after set to provide key.

5. Relieving Joints

   Divide the render into panels at no more than 5m horizontally and at storey heights vertically, and not more than 5m in both directions, by cutting through the render with a fine blade in a neat straight line.

6. Dissimilar Solid Backgrounds, etc.

   At junction of dissimilar backgrounds, and over relieving joints in blockwork, divide the render as in G6 above.
CERAMIC WALL TILES (09310)

A. Scope

This Specification covers ceramic wall tiling in selected sizes and colours.

The work shall include all necessary expansion and control joints and joint sealers as specified in section 07900; Sealants.

B. Performance and Standards


2. Tiles shall comply with the following Standards:

   a. European Standard
      - Water Absorption EN 99
      - Modulus of Rupture EN 100
      - Flexion Resistance EN 100
      - Abrasion Resistance EN 102
      - Scratch Hardness EN 101
      - Frost Resistance EN 202
      - Thermal Shock Resistance EN 104
      - Resistance to Bonding EN 100
      - Coefficient Of Linear Thermal Expansion EN 103
      - Chemical Resistance EN 106
      - Resistance to Home Chemical Products and Acids EN 122
      - Coefficient Of Friction BCRA
      - Tolerances EN 98

   OR

   b. ANSI/ASTM
      - Water Absorption ASTM C-373
      - Breaking Strength ASTM C-648
      - Scratch Hardness MOHS Scale
      - Abrasive Hardness ASTM C-501
      - Chemical Resistance ASTM C-650
      - Coefficient Of Friction ASTM C-1028
      - Wear Rating PEI
      - Thermal Shock ASTM C-484
      - Bonding Strength ASTM C-482
      - Tolerances ASTM C-499
CERAMIC WALL TILES (09310) (CONT'D)

B. Performance and Standards (Cont'd)

3. Acceptable water absorption according to ASTM C-373 shall be:

   a. For impervious Tiles: 0.5% or less
   b. For vitreous Tiles: More than 0.5% but not more than 3.0%
   c. For semi-Vitreous Tiles: More than 3.0% but not more than 7.0%
   d. For non-Vitreous Tiles: More than 7.0%

C. Related Items

Joint Sealers 07900
Ceramic Floor Tiles 09312

D. Submittals

1. Samples of Tiles

   For each specified type or colour of tile the Contractor shall supply for the Engineer's approval a panel of tiles not less than 300mm square stuck onto a backing board of hardboard or similar and grouted with the specified grout.

   The Contractor shall also submit full size samples of each tile accessory.

2. Sample of Work

   Before the generality of the work is commenced carry out one area of each type (not necessarily each colour) of tiling, not less than 4m sq. which, when approved, shall stand as the minimum standard of workmanship to be achieved. Where appropriate in the context of the work and as may be required by the Engineer the sample shall include a length of at least 1m of sealant jointing. The remainder of the work shall not proceed before approval has been given to this sample.

3. Data

   Copies of the tile and tiling materials manufacturer's data and fixing recommendations or instructions shall be handed to the Engineer, and tile fixing shall not be at variance with these instructions without the written agreement of the Engineer.
CERAMIC WALL TILES (09310) (CONT’D)

E. **Product Handling**

1. **Tiles**

   The tiles shall be transported and stored in the manufacturer's cartons with seals unbroken and labels intact until time of use.

   Tiles shall at all times be handled and stored to prevent damage and soiling.

2. **Pointing Mortar and Grout**

   Materials shall be transported and stored in the manufacturer's sealed containers until required for use and shall at all times be handled in accordance with the manufacturer's instructions.

3. **Cement and Sand Mortar**

   Cement and sand mortar shall be as specified in 04220 Concrete Unit Masonry.

F. **Materials**

1. **Ceramic Wall Tiles**

   a. **Source**

      i. European mass ceramic tiles shall be first quality as manufactured by "Marrazzi", "Graniti Fiandre", "Flaviken", "Imola" or approved equal to the approval of the Engineer.

      ii. Each type of tile shall be obtained from a single manufacturer together with all fittings and specials relating to that type.

   b. **Tiles**

      The tiles shall be to BS 1281 with cushion edges and spacer lugs. Fittings and specials shall be to BS 1281: round edge fittings shall be as Fig. 1 in the BS.
CERAMIC WALL TILES (09310) (CONT'D)

F. Materials (Cont'd)

1. Ceramic Wall Tiles (Cont'd)
   c. Sizes

   Size shall be 300 x 300 x 6mm or as otherwise agreed with the Engineer. Tolerances shall be in accordance with BS 6431. Thickness of tiles shall be approved by the Engineer.

d. Colours, Finish and Patterns

   Colours, finish and patterns for other items shall be selected by the Engineer and shall accurately match approved samples.

e. Defects

   The tiles shall be entirely free from defects and blemishes.

2. Mortar

   Cement and sand mortar shall be 1:3.

   The cement shall be portland cement to BS12. The water shall be clean, free of impurities and the least needed for proper workability.

   The bedding mortar shall consist of a mixture not richer than 1 part cement to 3 parts sand and not leaner than 1 part cement to 4 parts sand, and shall be not less than 12mm thick. The sand for the mortar shall be in all respects in accordance with the requirements of BS 1200. The cement shall be Portland Cement to BS 12. The water shall be clean and free of impurities.

3. Grout

   The ceramic tiles grout shall be determined by the Engineer. The grout shall be used in accordance with the instructions of the manufacturer. The Engineer shall determine what grout will be used if there was a danger of damp penetration.

   All inside corners shall be grouted with the appropriate sealant matching the grout colour.
CERAMIC WALL TILES (09310) (CONT'D)

G. Workmanship

1. General

   a. Manufacturer's recommendations are to be strictly followed for all products and materials.

   b. Standards

      Comply with the requirements of BS 5385, Part 1.

   c. Setting Out

      The tiling shall be set out strictly in accordance with the Engineer's drawings or approved Contractor's drawings.

      Cut tiles shall be kept to a minimum and shall not be less than half the width of a full tile. Joints shall be truly horizontal and vertical and horizontal joints in adjacent walls shall align. All joints shall be 1.5mm wide or as determined by spacers.

   d. Tolerance

      Maximum permissible gap under a 2m straight edge shall be 3mm.

      Owing to variations which may occur in tile sizes within the limits of UNIEN 103, the Contractor shall be responsible for sorting all tiles into batches after delivery to site and before any fixing is commenced. Each batch shall contain tiles of the same size and the tiler shall apportion the batches to ensure that only tiles of one size are used in any one room.

   e. Corners

      Tiling at external corners shall be splayed and joined in 45° setting. The thickness of wall tiling shall not in any case be exposed.

2. Background

   a. Acceptance of Background

      Before fixing tiling ensure that the background is:

      i. Adequately true and level to achieve specified tolerances.
      ii. Free from contamination and loose areas.
      iii. Adequately prepared to give a good bond.
CERAMIC WALL TILES (09310) (CONT'D)

G. Workmanship (Cont'd)

3. Fixing
   a. Preparation of Tiles
      Tiles which are dirty or have a coating of dust shall be cleaned with
      clean water, but must be entirely dry before application of adhesive.
   b. Adjustment
      Make any necessary adjustment to tiles within 10 minutes of fixing.
   c. Cleaning Off
      Remove surplus mortar as soon as bedding is complete. Do not
disturb tiles.

4. Grouting
   When bedding has set sufficiently to prevent disturbance of tiles, but not
more than 7 days after fixing, all joints are to be grouted by working ceramic
tile grout in so that the joint is completely filled. Finish flush and thoroughly
clean off surplus grout as the work proceeds using a damp cloth. Tool joints
smooth.

5. Finishing
   The finished work shall be left clean and free from cement, plaster, paint,
dust or any other marks or imperfections; cleaning down must not be carried
out with materials which will scratch or in any way impair the finished
work.
   Final polishing shall be done with a soft dry cloth.

6. Protection
   The Contractor shall adequately protect the tiling from all damage,
howsoever likely to be caused, until the handing over. Any damage which
does occur shall be made good by the Contractor at his own expense. The
whole of the work shall be prepared for handover in a state satisfactory to
the Engineer.
CERAMIC FLOOR TILES (09312)

A. **Scope**

1. The extent of ceramic floor tiling is shown on drawings and in schedules.
2. This section covers ceramic floor tiles and skirtings.
3. The work shall include all necessary expansion and control joints and joint sealers as specified in section 07900: Sealants.

B. **Performance and Standard**

1. The whole floor, including bedding and jointing materials shall be capable of resisting the action of acids, oils or fats to which it can be expected to be subjected according to its location in the project.
2. The ceramic floor tiling shall be carried out in accordance with BS CP 202.
3. The tiles shall conform to European Standards listed in Clause B2 in Section 09310.

C. **Related Items**

- 07900 Joint Sealers
- 09310 Ceramic Wall Tiles

D. **Submittals**

1. **Sample Tiles**

   The Contractor shall submit for the Engineer's approval sufficient plain flooring tiles to indicate the quality and range of colour or shade variety that can be expected.

2. **Sample Panel**

   Following initial selection of a specific tile the contractor shall submit a panel not less than 1m square of the tiles stuck onto an appropriate rigid backing sheet with joints of the specified width pointed with the specified grout.
CERAMIC FLOOR TILES (09312) (CONT'D)

D. **Submittals (Cont'd)**

3. **Sample Floor**

   Following approval of the sample panel the Contractor shall lay one complete room floor which, when approved, shall remain as the standard by which the remainder of the work shall be judged.

   The room shall be one selected by the Engineer, and shall include a movement joint which shall be completed with the specified joint sealer as part of the sample.

4. **Compliance with Standard**

   The Contractor shall supply a written statement of compliance with the specified standard in respect of each type of tile submitted.

5. **Data**

   Copies of the manufacturer's data and fixing recommendations shall be handed to the Engineer. Any variation between such recommendations and the requirements of this Specification shall be called to the attention of the Engineer.

E. **Product Handling**

1. **Tiles**

   The tiles shall be transported and stored in the manufacturer's cartons with seals unbroken and labels intact until time of use.

   Tiles shall be handled and stored at all times to prevent damage and soiling.

2. **Bedding Materials**

   Cement, aggregates, etc., shall be handled and stored.

3. **Mortar**

   Cement and sand mortar shall be 1:3.

   The cement shall be portland cement to BS12. The water shall be clean, free of impurities and the least needed for proper workability.
CERAMIC FLOOR TILES (09312) (CONT’D)

E.  **Product Handling (Cont’d)**

3.  **Mortar (Cont’d)**

The bedding mortar shall consist of a mixture not richer than 1 part cement to 3 parts sand and not leaner than 1 part cement to 4 parts sand, and shall be not less than 12mm thick. The sand for the mortar shall be in all respects in accordance with the requirements of BS 1200. The cement shall be Portland Cement to BS 12. The water shall be clean and free of impurities.

F.  **Materials**

1.  **Tiles**

   a. Tiles shall be anti-slip mass tiles, first quality European as manufactured by "Marrazzi", "Graniti Fiandre", "Flaviken", "Imola" or approved equal to the approval of the Engineer. Each type of tile shall be obtained from a single manufacturer together with all fittings and specials relating to that type.

   b. All tiles shall be in accordance with European Standards as listed in Clause B2 in Section 09310.

   c. Tiles shall have an approved anti-slip surface produced by the nature of the tile ingredients and not by ribbing, projecting studs or other form of surface profiling.

   d. **Sizes**

   Size shall be 300 x 300 x 6mm as indicated on drawings or as directed by the Engineer.

   e. Skirting tiles shall be 80mm high x 6mm thick skirtings and shall match the floor tiles and be from the same manufacturer.

   f. **Colours, Finish and Defects**

   These shall be selected by the Engineer and shall accurately match approved samples. The tiles shall be entirely free from defects and blemishes.

   Ceramic tiles shall be mat.
CERAMIC FLOOR TILES (09312) (CONT'D)

F. **Materials (Cont'd)**

2. **Bedding Materials: Mortar**

   Cement shall be Portland Cement to BS 12. Sand shall comply with the requirements of BS 1200 clean, sharp, not too fine and free from clay, organic or soluble matter. Sea sand shall not be used. The mixture shall be not richer than 1:3 and not leaner than 1:4, cement: sand, and the mortar shall not be less than 12mm thick.

3. **Grout**

   The grouting mortar shall be flooring grade coloured grout to the Engineer's approval.

G. **Workmanship**

1. **General**

   The floors shall be laid in accordance with BS CP 202.

2. **Inspection and Protection of Base**

   The Contractor shall inspect the base on which the ceramic tiles are to be laid. The base surface shall be thoroughly clean, free from dust, oil, plaster, lime or other foreign materials immediately before tile laying is commenced.

3. **Bay Division**

   The floor areas shall be sub-divided into bays not exceeding 10m² with the long side of each bay not exceeding the shorter side by more than one and a half times.

   Movement joints around the perimeter of the floor and at bay sub-divisions shall be 6mm wide, through the depth of the tile and bed, filled with strip filler materials and finished with sealant.
CERAMIC FLOOR TILES (09312) (CONT'D)

G. Workmanship (Cont'd)

4. Ceramic Tile Fixing

Ceramic tile fixing shall be carried out in accordance with BS CP 202 and manufacturer's instructions.

5. Grouting

The tiling shall be grouted on completion with non-shrink grout of a colour to match the tiles, ensuring, that all joints are completely filled.

Surplus grout is to be cleaned off the face of the tile and adjoining surfaces and the tiles are to be carefully cleaned.

6. Final Cleaning

The final polished surface is to be washed with hot water and alkali-free detergent, and left clean and protected from damage to the satisfaction of the Engineer.
TERRAZZO (09420)

A. **Scope**

1. The work under this heading consists of the supply, delivery and installation of first quality plain mass terrazzo floor tiles with marble chips.

2. The terrazzo finish shall consist of marble chips and tinted cement.

3. Treads, risers and skirting shall be delivered pre-polished.

B. **Performance and Standards**

1. The work shall be carried out to BS CP 204 Part 2, and shall conform with the latest recommendations of the British National Federation of Terrazzo-Mosaic Specialists. Precast terrazzo tiles shall comply with BS 4131, and shall be laid in accordance with BS CP 204.

C. **Related Items**

Beds and Screeds 03500
Wood Flooring 09570

D. **Submittals**

1. **Samples Terrazzo Tiles**

   The Contractor shall submit for approval two tiles of each of the colours selected for plain terrazzo tiles.

2. **Samples of Terrazzo Marble Chippings**

   Samples of the marble chippings used in the sample shall be submitted for approval.
E. **Product Handling**

1. **Transit and Delivery**

   Adequate protection shall be given to the tiles for transit purposes to avoid chipping of arises, cracking, and contact with any material that might cause discoloration.

2. **Stacking Tiles on Site**

   The recommendations of Appendix C of BS 4131 shall be followed.

F. **Materials**

1. **Plain Mass Terrazzo**

   Mass terrazzo shall be first quality mass terrazzo through the full thickness of tiles with marble fine chips, without resin obtained locally to the approval of the Engineer and shall have the following characteristics:

<table>
<thead>
<tr>
<th>Performance</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensional Tolerance</td>
<td>Conforms to BS 4131</td>
</tr>
<tr>
<td>Transverse Strength</td>
<td>Conforms to BS 4131</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>Conforms to BS 4131</td>
</tr>
<tr>
<td>Scratch Hardness</td>
<td>Conforms to Mons scale (1:talc 10:diamond)</td>
</tr>
<tr>
<td>Taber Abrasion</td>
<td>Conforms to ASTM 501</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>High high resistance to impact</td>
</tr>
<tr>
<td>Anti-Static</td>
<td>Conforms to BS 2050</td>
</tr>
</tbody>
</table>

   Mass terrazzo floor tiles sizes shall be 400 x 400 x 20mm thick or as otherwise indicated on the drawings.

   Treads, riser and skirtings shall be to dimensions and thickness shown on the drawings and indicated in Bill Items.

2. **Bedding Mortar**

   The bedding mortar shall consist of a mixture not richer than 1 part cement to 3 parts sand and not leaner than 1 part cement to 4 parts sand, and shall be not less than 12mm thick. The sand for the mortar shall be in all respects in accordance with the requirements of BS 1200. The cement shall be Portland Cement to BS 12. The water shall be clean free of impurities.
TERRAZZO (09420) (CONT'D)

F. **Materials (Cont'd)**

3. **Joint Filling Mortar**

   Grouting of joints shall be with mortar using cement of the same colour as that used in the manufacture of the tiles.

4. **Bonder**

   The bonder shall be PVA based adhesives.

5. **Sand and Aggregate for Screeds**

   The sand for rendering screeds shall comply with BS 1199: 1955, Table 1 and shall be clean, sharp.

   All sand shall be free from loam or other impurities.

   Crushed shingle shall be clean washed, conforming to the requirements of BS 882 for coarse aggregate and be graded 3/8" down.

6. **Adhesive**

   Adhesive shall be recommended by the manufacturer of terrazzo complying with BS1204, Part 1.

G. **Workmanship**

1. **General**

   The floors shall be laid in accordance with BS CP 202, and 204.

2. **Floor Thickness**

   The overall thickness from structural concrete slab to finished surface of terrazzo tile on floors shall not exceed 100mm.

3. **Preparation of Base**

   The base surface shall be thoroughly clean, free from dust, oil, plaster, lime or other foreign materials immediately before tile laying is commenced.
TERRAZZO (09420) (CONT'D)

G. Workmanship (Cont'd)

4. Terrazzo Tile Fixing

Tiles shall be fixed by bedding on mortar bed which may be bonded to the screed base or alternatively laid on a separating layer, at the discretion of the Contractor who shall be solely responsible for making any adjustments including dimensional adjustments, to the satisfaction of the Engineer, which his choice necessitates.

5. Mortar Bed Method

a) If the bed is bonded to the screed the bonding agent as specified shall be applied in accordance with the manufacturer's instructions and the mortar bed shall be laid to a thickness not less than 12mm and not more than 20mm, and in other respects in accordance with clause 4.2.2 of BS CP 202.

b) If the bed is laid on a separating layer, this layer shall be laid with joints lapped not less than 100mm. The mortar bed shall be approximately 20mm + or - 5mm, and shall be laid in accordance with clause 4.2.3 of BS CP 202.

6. Adhesive

Tiles indicated to be fixed with adhesive shall be fixed in accordance with the recommendations of the Manufacturer.

7. Grouting

The tiling shall be grouted on completion with grout of neat cement of a colour to match the tiles, ensuring that all joints are completely filled.

Surplus grout is to be cleaned off the face of the tile and adjoining surfaces and the tiles are to be carefully cleaned.

8. Curing

Curing shall be carried out as recommended in BS CP 202.
TERRAZZO (09420) (CONT'D)

G. Workmanship (Cont'd)

9. Finishing and Polishing

a. Grinding: The initial rubbing shall be accomplished by floor machines outfitted with No. 24 or finer grit stones. A second rubbing, using No. 80 or finer grit-stones, shall immediately follow initial rubbing for under carpet.

b. Grouting: Immediately following rough grinding, surfaces shall be cleansed with sufficient clean water to remove dust and fines. Rinse thoroughly with an abundance of clean water. Remove excess, and apply paste consistency Portland cement grout of type employed in the topping, by hand or machine, with pigment added in like amounts where called for in matrix; fill all voids.

c. Finish

All exposed surfaces shall be polished with approved graded abrasives and plentiful supply of clean water as follows:

i. Removal of protruding edges, and leveling tiled surfaces with grade 5 abrasive stone.

ii. Removal of scatches with grade 1 abrasive stone.

iii. Re-grouting in white cement to refill gaps between tiles.

iv. Removal of excess white cement grouting material with disc power machine grade 80 1st coat and grade 180 2nd coat and repolish surface and corners with grade 2 abrasive stone.

v. Polish exposed surface to remove any edges, cuts, stains left with grades 2 or 3 abrasive stone.

vi. Final clean.

d. Curing Grout: As soon as the grout has obtained initial set, cover the entire surface with a generous application of specified curing material; allow to remain indefinitely to help protect finishes from staining until final polishing.
TERRAZZO (09420) (CONT'D)

G. Workmanship (Cont'd)

9. Finishing and Polishing (Cont'd)

e. Fine stoning: Final machine rubbings shall not take place sooner than three days following the grouting. The grouting shall be removed by means of floor machines using No. 80 or finer grit stones.

Immediately following the machine rubbing or fine stoning, wash all surfaces with a solution of neutral cleaner, and rinse. As soon as the surfaces are thoroughly dry, apply sealer. The sealing shall be done in strict accordance with the manufacturer’s directions, leaving a polished floor approved by Engineer.

10. Traffic

Allow no traffic on the floor until 4 days after completion of laying and jointing, and then only light traffic for a further 10 days.

11. Final Cleaning

The final polished surface is to be washed with hot water and alkali-free detergent, and left clean and protected from damage to the satisfaction of the Engineer.
SUSPENDED CEILING SYSTEMS (09515)

A. **Scope**

1. This section covers suspended ceilings consisting of panels or boards complete with suspension system and all necessary trims and accessories.

B. **Performance and Standards**

1. **Suspension System**

   The suspension system shall be designed to provide substantial support for the ceiling finish and associated light fittings, and for grilles, margins and any item forming part of the finished ceiling, in order that the soffit of the ceiling remains permanently true and level.

2. **British Standards**

   All materials shall comply with the relevant current British Standards.

   Workmanship shall be in accordance with BS CP 290.

C. **Related Items**

   05010  Metal First Fixing Materials
   09120  Ceiling Suspension Systems

D. **Submittals**

1. **Samples**

   The Contractor shall supply samples for approval of each size and type and of such other component members as may be called for by the Engineer.
D. **Submittals (Cont'd)**

2. **Shop Drawings**

   The Contractor shall submit for approval shop drawings showing all necessary details, including trimming for light fittings, grilles, laboratory service boxes, etc., perimeter details, and all suspension and fixing details.

   The Contractor shall submit also layout drawings for each type of room or space which has a suspended ceiling.

   Drawings shall be submitted so that they can be cleared by the Engineer as may be required to progress the main works and specialist's work, but in any event not late than 21 working days before the work is put in hand.

E. **Product Handling**

1. **Protection and Handling Generally**

   Prevent distortion or damage or panels and other components during transit, handling, storage and fixing.

   Store under cover.

   Protect metal finishes as specified in Section 05030.

   Prevent contact with wet plaster or cement or any other deleterious matter.

   Provide protective coverings as necessary and remove all protection on completion.

F. **Materials**

1. **Gypsum Board Suspended Ceiling**

   Gypsum board shall be 12.7mm anchored to suspension system as shown on the drawings and schedules. Product of "Benjamin Moore", "Lafarge" or approved equal.

2. **Metal Strip Suspended Ceiling**

   Metal suspended ceilings shall be strips of 100mm wide as indicated on drawings and shall be in prepainted polysatin paint, as manufactured by "Saddimetal" or approved equal.
**SUSPENDED CEILING SYSTEMS (09515) (CONT'D)**

### F. Materials (Cont'd)

#### 3. Cement Boards

Cement board shall be 13mm thick anchored to suspension system. Cement board shall be moisture resistant obtained from E-Board Classic range as manufactured by "Eternit Everst Ltd" or approved equal.

Cement board shall have the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density kg/m³</td>
<td>1250 ~ 1350</td>
</tr>
<tr>
<td>Bending strength N/mm²</td>
<td>9.0</td>
</tr>
<tr>
<td>Modulus of Elasticity N/mm²</td>
<td>4500</td>
</tr>
<tr>
<td>Tensile strength perpendicular to surface N/mm²</td>
<td>0.5</td>
</tr>
</tbody>
</table>

#### 4. Access to Ceiling Void

All access panels must be demountable without disturbance to adjacent units, by means of a key, without distortion or risk of damage to the suspended ceiling.

#### 5. Accessories

The system is to be complete with all necessary accessories including infill channels, perimeter trim, etc., as may be shown on the Engineer's or manufacturer's approved drawings.

#### 6. Suspension

The suspension system shall consist of angle hangers or suspension wires, primary suspension channels and main runners, with all necessary clips. The main runners shall be of the split 'T' type to give a fully concealed fixing system. All members shall be zinc sprayed, sherardized or given other approved protective coating.
SUSPENDED CEILING SYSTEMS (09515) (CONT’D)

G.  Workmanship

1. General

The Contractor shall set out the whole ceiling in accordance with the approved drawings, in such a way that close tolerances are achieved. The deviation from the nominal shall not be in excess of + or - 3mm over 4m length, non-accumulative.

Method of erection and all workmanship shall be in accordance with the instructions of the manufacturer of the ceiling system, and with the relevant clauses BS CP 290.

2. Suspension

The method of fixing hangers to the structural soffit shall be agreed with the Engineer.

3. Additional Loads on Suspension System

Light fittings, ventilation diffusers, etc., are to be supported on the ceiling suspension at ceiling level and the Contractor shall allow for substantial support for these loads when designing the system. He shall liaise with the manufacturers of the various items so that they are compatible with the ceiling system, and he shall incorporate the necessary runners, lugs or other support to fix or rest on the ceiling suspension.

4. Installation

Ensure that only boards bearing the same batch number are used in any one space.

All wet trade activities shall be completed and dried out before panel installation is commenced.

5. Cut Ends, etc.

All cut ends and any damage to protective coatings shall be made good before fixing to ensure that no subsequent staining will occur on the finished work and no corrosion will occur in the ceiling void or on any member.
SUSPENDED CEILING SYSTEMS (09515) (CONT’D)

G. Workmanship (Cont’d)

6. Fixings, Miscellaneous

The panel and tile fixing system is an invisible one; no visible fixing will be permitted unless there is no alternative; if unavoidable, screws shall be countersunk with flat Phillips head, stove enameled to match the panel or tile. All concealed screws and bolts shall be sherardized and of sufficient strength for their purpose.

The used of timber is to be avoided where possible, but if necessary, shall be in all respects as specified in section 06400.

7. Cleaning, Protection and Patching

a. Be responsible for cutting and patching of defects appearing in the gypsum board work, after the work of other trades has been completed, regardless of how, or by whom, the damage was caused. Patching shall be neatly and properly made to match the original work. Portions of the work damaged beyond repair shall be removed and replaced with new material at no additional cost to the Employer.

b. Clean and repair surfaces soiled or damaged in connection with the work of this Section to the approval of the Engineer. Pay the cost of replacing finishes or materials that cannot be satisfactorily cleaned.

c. Upon completion of the work, remove debris, equipment and excess material resulting from the work of this Section from the site.

d. Protect completed work from damage through construction period.
WOOD FLOORING (09570)

A. **Scope**

1. Provide labour, materials, equipment and services, and perform operations required for installation of wood flooring and related work as indicated on the drawings and specified herein.

2. **Work Included**

   The work of this section shall include, but not be limited to, the following:

   a. Wood massive flooring including underlayment and sleepers as indicated on the drawings.
   
   c. Wood saddles.

B. **Performance and Standards**

1. Materials and work shall conform to the latest edition of reference specifications specified herein and to applicable codes and standards.

   a. Comply with recommendations of National Oak Flooring Manufacturer’s Association (NOFMA), unless specified otherwise and approved by the Interior Designer.

   b. **Wood Flooring Standard**: Comply with recommendations of APA-1 by Parquet Association, Inc.

2. Installer shall be a firm specializing in wood flooring with no less than three (3) years successful experience in installation of types specified.

3. Obtain materials of each type from single a manufacturer or source to insure match of quality, colour, pattern and texture.

4. Prepare a job site mockup of wood flooring at an area designated by the Interior Designer of approximately 5m² (50 sq. ft.) for approval. Obtain approval of mockup prior to proceeding with the work. Mockup shall remain in place to serve as job standard and may, with Interior Designer’s approval, become part of the completed work.
WOOD FLOORING (09570) (CONT'D)

C. Related Items

06100 Rough Carpentry
09420 Terrazzo

D. Submittals

1. Product Data

Copies of manufacturer’s latest published literature for materials specified herein shall be submitted for approval, and approval obtained before materials are delivered to the site.

2. Shop Drawings

Submit shop drawings showing pattern of wood flooring and related construction (underlayment, sleepers) and obtain approval prior to delivery of materials to the job site.

3. Samples

Samples of materials specified herein and applying to this section shall be submitted for approval, and approval obtained before materials are delivered to the site.

Submit sets of ranges including finish on 75 percent of each sample.

4. Maintenance Instructions

Submit manufacturer’s written instructions for recommended maintenance practices for flooring.

5. Manufacturer's Installation Instructions

Submit standard and special installation procedures, perimeter conditions requiring special attention. Include manufacturer's recommendations for accessory products.

6. Closeout Submittals

Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, a suggested schedule for cleaning, stripping, and re-finishing, stain removal methods, and polishes and waxes.
WOOD FLOORING (09570) (CONT'D)

D. Submittals (Cont'd)

7. Qualifications

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Installer: Company specializing in performing Work of this section with minimum three years documented experience.

8. Mock-Up

Construct mock-up, 1000 x 1000mm, which includes typical field and edge conditions.

Locate where directed.

Mock-up may remain as part of the Work.

9. Environmental Requirements

a. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized between 35 and 50 percent and temperature is stabilized between 65 and 80 degrees F.

i. Do not install wood flooring until wood materials have been acclimated to ambient temperature and humidity conditions for a minimum of 72 hours. Stack wood for acclimation procedures to facilitate cross-ventilation of wood materials.

b. Provide heat, light, and ventilation prior to installation.

c. Maintain room temperature and humidity for a period of two days prior to delivery of materials to installation space, during installation, and continuously after installation.

10. Coordination

Coordinate the works in this section with the floor heating installations.
WOOD FLOORING (09570) (CONT'D)

E. **Product Handling**

1. **Moisture Content**

   At time of delivery, limit average moisture content of wood flooring to 12 percent, with 14 percent maximum for any piece.

2. Protect wood flooring from excessive moisture in shipment, storage and handling. Deliver in unopened cartons or bundles and store in a dry place with adequate air circulation. Do not deliver material to building until “wet work” such as concrete and plaster have been completed and cured to a condition of equilibrium.

F. **Materials**

1. **Wood Parquet Flooring**
   a. Wood Flooring: Mahogany 13mm thick as shown on the drawings and as described on schedules comprising massive wood planks with tongue and groove connections fixed on terrazzo flooring as indicated.
   b. Moisture Content: 12 to 14 percent.
   c. Adhesive: as recommended by manufacturer.
   d. Vapor Retarder: Black polyethylene sheet, 0.2mm thick, 50mm wide tape for joint sealing.
   e. Sheathing Paper: Waxed Kraft paper.
   g. Ventilating Base: Molded rubber, ventilating type, with adhesives and accessories, color as selected.

2. **Accessories**
   a. Wood Plugs: Round shape, 19mm diameter x 3mm thick, of same species as flooring.
   b. Divider Strip: Angle strips oxidized brass.
   c. Floor Finish: Urethane to achieve satin sheen surface; type recommended by flooring manufacturer.
   d. Sealer and Wax: Types recommended by flooring manufacturer.
WOOD FLOORING (09570) (CONT’D)

F. Materials (Cont’d)

3. Adhesive / Mastic

Mastic of type recommended by manufacturer of flooring, and complying with flammability and environmental control restriction. Mastic shall be non-flammable.

4. Fasteners

As recommended by manufacturer, but not less than recommended by NOFMA in "Installation Manual".

5. Stain

Penetrating type non-fading wood stain of colour selected by the Interior Designer.

6. Wood Filler

Paste type wood filler, pigmented to match sample approved by the Interior Designer.

7. Floor Sealer

Penetrating type, pliable, wood-hardening finish/sealer; Penetrating Seal #21 by Hillyard Chemical Co., or Penetrating Triple XXX Seal-O-San by Huntington Laboratories, Inc. or equivalent sealer as recommended by flooring manufacturer and manufacturer of finishing materials.

8. Urethane Finish

FS TT-C-542, specially compounded for wood floor finish, moisture curing type, for multiple-coat application as recommended both by the flooring and finishing manufacturer.

G. Workmanship

1. General

Do not proceed with installation of wood flooring until spaces have been enclosed and are at approximate humidity condition planned for occupancy. Condition wood for 5 days prior to start of installation by placing in spaces to receive flooring and maintaining ambient temperature between 18 and 21°C (65 and 70°F) before, during and after installation. Open packages of wood flooring which are sealed (if any) to permit natural adjustment of moisture content.
WOOD FLOORING (09570) (CONT’D)

G. Workmanship (Cont’d)

2. Inspection and Protection of Base

Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

3. Preparation

a. Dryness of sub-floor shall be determined by approved moisture test made in accordance with recommendations of approved floor manufacturer and NOFMA. Certify compliance with moisture test and results thereof in writing to Interior Designer and manufacturer of flooring.

b. Certify condition of sub-floor and acceptance of same in writing to Interior Designer.

c. Start of work shall imply acceptance of existing surfaces and conditions.

d. Prepare substrate to receive wood flooring in accordance with manufacturer's instructions.

e. Broom clean substrate.

4. Installation

a. Comply with flooring manufacturer’s instructions and recommendations, but not less than recommended by NOFMA in "Hardwood Flooring Installation Material", by recommendations of APA, Inc.

b. Wood Flooring:

i. Install in accordance with manufacturer's instructions using adhesive.

ii. Lay flooring in patterns indicated on drawings. Verify alignment as work progresses.

iii. Arrange flooring with end matched grain set flush and tight.
WOOD FLOORING (09570) (CONT'D)

G. Workmanship (Cont'd)

4. Installation (Cont'd)

b. Wood Flooring: (Cont'd)

   iv. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar. Provide divider strips.

   v. Install edge strips at unprotected or exposed edges, and where flooring terminates. Secure metal strips after installation of flooring with stainless steel screws.

c. Install floor inserts to a depth sufficient to ensure flush top surface with floor surface.

d. Finishing:

   i. Mask off adjacent surfaces before beginning sanding.

   ii. Sand flooring to smooth even finish with no evidence of sander marks. Take precautions to contain dust. Remove dust by vacuum.

   iii. Apply filler and stain and three finish coats.

   iv. Apply first coat, allow to dry, then buff lightly with steel wool to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.

   v. Apply second and successive coat. Allow to dry. Lightly buff between coats with steel wool and vacuum clean before applying succeeding coat.

e. Pattern

   Comply with pattern or direction of pattern for laying wood flooring as indicated on drawings.

f. Expansion Space

   Provide expansion space at walls and other obstructions and terminations of flooring, not less than 12.7mm (1/2 inch) unless otherwise indicated on drawings. Unless fully concealed by trim, fill expansion space with flush cork expansion strip. Nail show molding or other trim to baseboard, rather than to flooring.
WOOD FLOORING (09570) (CONT’D)

G. Workmanship (Cont’d)

4. Installation (Cont’d)

  g. Parquet Flooring Installation

  Set in adhesive / mastic in accordance with manufacturer's instructions and recommendations.

  h. Finishing Wood Flooring

  - Machine sand installed materials to remove offsets and non-level conditions, ridges, cups, and sanding machine marks which would be visually noticeable after finishing. Use 3 grades of sandpaper, ending with 00 grade. Completely clean and immediately apply finish. Do not permit traffic on floor after sanding and until finish is completed. Cover sanded floor with building paper to provide access for application of first finish coats.

  - Apply approved stain in accordance with stain manufacturer's recommendations.

  - Apply wood filler by brush, followed by wiping across grain to work into pores and cracks.

  - Apply floor sealer, in accordance with manufacturer's instructions, including machine buffing with steel wool, in-the-wet where recommended by manufacturer.

5. Extra Stock / Replacement Material

After completion of wood flooring work, deliver to project site not less than 1.0 percent of quantity of each type wood flooring installed on the project. Provide in manufacturer’s original, unopened cartons or bundles.

6. Cleaning

Clean and polish floor surfaces in accordance with manufacturer's instructions.

7. Protection Of Installed Construction

Prohibit traffic on floor finish for 48 hours after installation.
WOOD FLOORING (09570) (CONT'D)

H. Warranty

Submit 3-year warranty signed by Manufacturer and Installer, agreeing to repair or replace wood flooring which shrinks, warps, cracks or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials and/or workmanship rather than to unusual exposure to moisture or other abusive forces or elements not anticipated for application.
MARBLE (09615)

A. **Scope**

This section specifies polished marble tiles for thresholds, all as shown on the drawings.

B. **Performance and Standards**

The work shall be carried out in accordance with BS CP 202, including all current amendments.

Marble shall meet requirements of ASTM C-503 for group A marble.

C. **Quality Assurance**

All marble shall be provided from a single source from a single quarry to ensure consistency of quality and colour.

D. **Related Items**

04100 Masonry Mortar

E. **Submittals**

1. **Sample of Marble**

The Contractor shall provide an adequate number of samples of the specified marble, to demonstrate the range of colour and surface marking that will obtain in the finished work. When approved by the Engineer the samples shall be so marked and retained on site, and the work will be expected to lie within the demonstrated range.

Submit sample of coloured mortar.
MARBLE (09615) (CONT'D)

E. Submittals (Cont'd)

2. Shop Drawings
   a. The Contractor shall prepare and submit shop and setting drawings of all work included herein for the Engineer's approval.
   b. Shop and setting drawings shall show in detail all sizes, arrangement of joints and all provisions for anchoring.
   c. Shop drawings shall be submitted as directed by the Engineer.
   d. All installed materials shall conform to the approved corresponding shop drawings.
   e. The Contractor shall submit an approved layout drawings of any pattern required.

3. Measurements

The Contractor shall take all necessary measurements at the building as required to assure proper fabrication and installation of the work of this section.

4. Coordination

All work of this section shall be closely coordinated with the work of other sections whose work affects or is affected by the work specified in this section.

F. Product Handling

1. Marble
   a. Protect marble from damage and soiling during loading, shipment, delivery and storage.
   b. Handle and store marble to prevent chipping, breakage, soiling or other damage. Do no use pinch or wrecking bars without protecting edges of marble with wood or other rigid materials. Lift with die-belt type slings wherever possible. Do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.
MARBLE (09615) (CONT'D)

F. **Product Handling (Cont'd)**

1. Marble (Cont'd)

c. Store marble on wood skids or pallets, covered with nonstaining, waterproof membrane and place at least 6 inches above the ground. Place and stack skids and marbles to distribute weight evenly and to prevent breakage or cracking of marbles. Protect stored marble from weather with waterproof nonstaining covers or enclosures, but allow air to circulate around marble.

d. Broken, cracked, chipped, stained or damaged marbles shall be subject to rejection by the Engineer whether built-in or not and replaced at the Contractor's expense.

F. **Materials**

1. Marble

The marble generally shall be Italian first quality "Travertine" to the approval of the Engineer as indicated in Bill items.

The Contractor shall precise the properties of marble depending on the quarry it becomes from. However, it is recommended that the standards of ASTM, which are identical, be followed:

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Test Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption by Weight, Max. %</td>
<td>0.20</td>
<td>C97</td>
</tr>
<tr>
<td>Density, min., lb./cu.ft.</td>
<td>162</td>
<td>C97</td>
</tr>
<tr>
<td>Compressive Strength, min., PSI</td>
<td>7500</td>
<td>C170</td>
</tr>
<tr>
<td>Modulus of Rupture, min., PSI</td>
<td>1000</td>
<td>C99</td>
</tr>
<tr>
<td>Abrasion Resistance, min., hardness</td>
<td>10</td>
<td>C241</td>
</tr>
<tr>
<td>Flexural Strength, min., PSI</td>
<td>1000</td>
<td>C880</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
<td>.60</td>
<td>C108-89</td>
</tr>
</tbody>
</table>

The actual marble used shall be sound, of uniform texture, and shall be free from holes, seams, shakes and other defects which would impair the strength, durability or appearance of the work, as determined by the Engineer.
MARBLE (09615) (CONT'D)

F. Materials (Cont'd)

2. Sizes

As shown on the drawings and as indicated in the Bills of Quantities all to the approval of the Engineer.

3. Finish

All marble shall be pre-polished.

4. Bonding

Cement and sand mortar, 1:4-6.

5. Grout

The grout shall be to an approved colour, from an approved manufacturer.

6. Accessory Materials

Anchors, dowels, ties, cramps and supports shall be galvanized steel ASTM A167, type 304 and ASTM A276, type 304 as applicable, shall be provided by marble fabricator/supplier and as approved by the Engineer.

G. Workmanship

1. General

The manufacturer's recommendations shall be strictly followed for all products and materials.

2. Examination of Surfaces and Conditions

   a. All surfaces which will receive the work of this section and all conditions which affect the work of this section installation of the work of this section. Starting installation on any surface shall be construed as an acceptance of such surface and acceptance of all prevailing conditions, and as a waiver of any subsequent claim to the contrary.
MARBLE (09615) (CONT'D)

G. Workmanship (Cont'd)

3. Marble Generally
   a. All marble shall be accurately cut to the shapes, dimensions and profiles indicated on the drawings and in conformance with the approved shop and setting drawings.
   b. Installation shall be as specified for ceramic floor tiles.

4. Fixing
   a. Marble threshold shall be fixed to floors with mortar bed as specified in section 09420.

5. Mortar Joints
   a. Mortar shall consist of one part of non-staining white cement, one part plasticizer, and four parts fine sand.
   b. All mortar for joints shall be coloured to match the marble with which it is used.

6. Protection
   a. All work of this section, and related adjacent construction, shall be protected from damage, staining, or other imperfections at all times. Damaged, stained, or imperfect materials shall be repaired or replaced as directed by the Engineer, to the Engineer's satisfaction, without cost to the Employer.
   b. Use all reasonable means to keep the exposed surface of marble while being laid and particularly to keep it free from and/or caulking compound.

7. Cleaning
   a. All exposed surfaces of the work of this section and related adjacent surfaces shall be maintained in a clean condition, and upon substantial completion of the Contract shall be thoroughly cleaned to the satisfaction of the Engineer.
GRANITE (09620)

A. **Scope**

1. **Work Included**

   The Contractor shall furnish and install all granite and related work as required by the drawings and/or herein specified, generally as follows:
   
   a. Granite for floors and skirtings.
   
   b. Granite for floors, walls and facing of upstands in landscape areas.

B. **Quality Assurance**

1. The granite shall be provided by single source from a single Quarry to ensure consistency of color and quality.

2. The granite shall be quarried, fabricated, shaped, finished, prepared for lifting and handling, packaged and crated for shipment and shipped from overseas by a single granite Company.

3. Granite shall meet requirements of ASTM C615.

C. **Related Items**

   03500 Beds and Screeds
   09220 Portland Cement Plaster

D. **Submittals**

1. **Shop Drawings**

   a. The Contractor shall prepare and submit shop and setting drawings of all work included herein for the Engineer's approval.

   b. Shop and setting drawings shall show in detail all sizes, arrangement of joints, and all provisions for anchoring.

   c. Shop drawings shall be submitted as directed by the Engineer.

   d. All installed materials shall conform to the approved corresponding shop drawings.
D. **Submittals (Cont'd)**

2. **Samples**
   a. Samples of all materials proposed to be used shall be submitted for approval. Samples of granite shall show the extremes of variations in quality, texture, colour and finish. Materials incorporated in the finished work must be within the approved ranges of the approved samples or will be rejected.

   b. Samples shall be submitted as directed by the Engineer.

   c. Field mock-up for floor and wall tiling shall be erected on the site where directed by the Engineer. The panels shall be of sizes directed by the Engineer and shall include joint profile and mortar colour, and anchoring. The mock-up panels shall be immediately revised by the Contractor during the presence of the Engineer, if the Engineer so directs, until each panel is approved by the Engineer. All installed granite construction shall conform to approved mock-up panels. The mock-up panels shall remain intact until their removal is directed by the Engineer, and subsequently, shall be removed by the Contractor.

3. **Measurements**
   a. The Contractor shall take all necessary measurements at the building as required to assure proper fabrication and installation of the work of this section.

4. **Coordination**
   a. All work of this section shall be closely coordinated with the work of other sections whose work affects or is affected by the work specified in this section.
GRANITE (09620) (CONT'D)

E. Materials

1. Granite

   a. Granite shall be first quality flamed "Noir Mouchté Flame" as indicated on the drawings, and to the approval of the Engineer.

   b. The Contractor shall precise the properties of granite depending on the quarry it becomes from, however granite shall have the following minimum physical properties according to ASTM C-503:

      | Standard   | Property                           | Requirement          |
      |-------------|------------------------------------|----------------------|
      | ASTM C97    | Absorption by weight               | 0.4% max.            |
      | ASTM C97    | Density, min.                      | 160 lbs/CuFt         |
      |             |                                    | 2,560 kg/m³          |
      | ASTM C99    | Modulus of Rupture, min.           | 1,500psi             |
      | ASTM C170   | Compressive strength, min.         | 19,000psi            |
      | ASTM C241   | Abrasion Resistance, min.          | Ha=25.0              |
      | ASTM C880   | Flexural Strength, min.            | 1,200psi             |

   c. Sizes and thickness of granite shall be as detailed on the drawings and as indicated on Bill Items to the approval of the Engineer.

   d. The actual granite used shall be sound, of uniform texture, and shall be free from holes, seams, shakes, clay pockets, spalls, stains, starts, and other defects which would impair the strength, durability or appearance of the work, as determined by the Engineer.

   e. Inherent variations characteristic of the granite and the quarry from which the granite is obtained shall be brought to the attention of the Engineer at the time the samples are submitted for approval, and such variations shall be subject to approval of the Engineer.

   f. All granite shall be selected for background colour, veining, marking and matching, and shall run in even shades.

2. Mortar Setting Materials

   a. Cement shall be white cement conforming to ASTM C-150, Type 1, latest edition.

   b. Sand shall conform to ASTM C-144, latest edition.

   c. Water shall be clean and fresh, from the water supply system.

   d. Plasticizer may be used in mortar mixing. The products used and their proportioning shall be approved by the Engineer.
GRANITE (09620) (CONT'D)

F. Workmanship

1. Examination of Surfaces and Conditions

All surfaces which will receive the work of this section and all conditions which affect the work of this section installation of the work of this section. Starting installation on any surface shall be construed as an acceptance of such surface and acceptance of all prevailing conditions, and as a waiver of any subsequent claim to the contrary.

2. Granite

   a. All granite shall be accurately cut to the shapes, dimensions and profiles indicated on the drawings and in conformance with the approved shop and setting drawings.

   b. Exposed surface tolerance shall not exceed 3mm in 2.50 meters.

   c. Holes shall be cut in all granite weighing more than 50 pounds unless other methods of raising granite not requiring holes. No holes shall come closer than 50 to exposed faces of granite.

   d. Each piece of granite shall be anchored and fabricated to accommodate anchorage items.

   e. Facing granite shall be anchored to concrete with dovetail anchors engaged in dovetail slots. Anchor slots shall be furnished for installations as work of the concrete section spaced as indicated on the drawings.

   f. Joints of all granite shall be full and square for full thickness of the granite. All concealed surfaces of joints shall be sawed.

   g. Jointing, coursing, setting patterns and finish of granite shall be straight and aligned as shown on drawings.

   h. When setting granite, adjacent pieces shall be selected for similarity in colour, veining and matching.

   j. Granite shall be set accurately, true to line, plumb and level.

   k. All exposed surfaces shall be free from waves, and faces of granite in the same plane shall be flush at joints. Arises shall be sharp and true, square and continuous with adjoining arises.
GRANITE (09620) (CONT'D)

F. Workmanship (Cont'd)

2. Granite (Cont'd)

1. The Contractor shall have a thoroughly competent granite superintendent in charge of the granite at all times during the handling and setting of granite.

m. Granite shall be so delivered and handled to protect it from damage at all times. The patching or hiding of defects shall not be permitted. Granite chipped or stained on the surface shall be redressed or cleaned to remove all traces of such defects before it is set in place, or new granite shall be furnished as directed by the Engineer.

3. Mortar Bed Method

Tiles shall be fixed by bedding on mortar bed which may be bonded to the screed base or alternatively laid on a separating layer, at the discretion of the Contractor who shall be solely responsible for making any adjustments including dimensional adjustments, to the satisfaction of the Engineer, which his choice necessitates.

a) If the bed is bonded to the screed the bonding agent as specified shall be applied in accordance with the manufacturer's instructions and the mortar bed shall be laid to a thickness not less than 12mm and not more than 20mm, and in other respects in accordance with clause 4.2.2 of BS CP 202.

b) If the bed is laid on a separating layer, this layer shall be laid with joints lapped not less than 100mm. The mortar bed shall be approximately 20mm + or - 5mm, and shall be laid in accordance with clause 4.2.3 of BS CP 202.

4. Mortar Joints

a. Mortar shall consist of one part of non-staining white cement, one part hydrated lime, and four parts fine sand or five parts coarse sand.

b. All mortar for joints shall be coloured to match the granite with which it is used.
F. Workmanship (Cont'd)

5. Protection

a. All work of this section, and related adjacent construction, shall be protected from damage, staining, or other imperfections at all times. Damaged, stained, or imperfect materials shall be repaired or replaced as directed by the Engineer, to the Engineer's satisfaction, without cost to the Employer.

b. Use all reasonable means to keep the exposed surface of granite while being laid and particularly to keep it free from and/or caulking compound.

c. Protect granite flooring by a protection layer to the approval of the Engineer.

6. Cleaning

All exposed surfaces of the work of this section and related adjacent surfaces shall be maintained in a clean condition, and upon substantial completion of the Sub-contract shall be thoroughly cleaned to the satisfaction of the Engineer.

Remove flooring protection layer upon completion.

7. Traffic

Allow no traffic on the floor until 4 days after completion of laying and jointing, and then only light traffic for a further 10 days.
SPECIAL COATINGS (09800)

A. **Scope**

This section specifies, but not limited to the following:

1. Coating to resist ‘dusting’ of the concrete surfaces and to provide a non-slip finish in mechanical room and plastic coating to resist microbicidal effects.

This section should be read in conjunction with section Painting 09900.

B. **Performance and Standards**


C. **Related Items**

03500 Beds and Screeds  
09220 Portland Cement Plaster  
09900 Painting

D. **Submittals**

The Contractor shall submit sample of the selected colours to the Engineer, not less than 600 x 600mm, and shall decorate an area not less than 4 square metres in a location chosen by the Engineer with the approved colour, as a sample of workmanship, texture, colour and coverage.

The Contractor shall obtain the Engineer's approval to any alternative material to that specified.
SPECIAL COATINGS (09800) (CONT’D)

E. **Product Handling**

1. The material shall be delivered in the manufacturer's sealed containers, labeled and dated etc., all in accordance with the appropriate clauses in section 09900 D.

2. **Manufacturer's Data**

   The Contractor shall furnish the Engineer with copies of the manufacturer's information sheets and instructions.

F. **Materials**

1. **Line Marking**

   Shall be safety abrasive flooring ‘Epoxy’ type or other approved equal surface applied coating containing a fine grade carborandum or other approved abrasive component.

2. **Coating to resist ‘dusting’ of the concrete surfaces**

   The coating shall be safety abrasive polyurethane flooring type or other approved equal surface applied coating containing a fine grade carborandum or other approved abrasive component.

   The colour shall be selected by the Engineer from the manufacturer's standard range and shall match the approved sample.

   Coating shall be as follows:

   - Heavy duty: Prime + 4 coats + aggregate, thickness 2.5mm.
   - Medium duty: Prime + 2 coats + aggregate, thickness 2mm.
   - Light duty: Prime + 2 coats, thickness 1.4mm.
SPECIAL COATINGS (09800) (CONT'D)

G. **Workmanship**

1. **Coating**
   
a. **General**

   The application shall be in accordance with the manufacturer's instructions.

   Preparatory Work: Patch voids, pop-outs, honeycombed, delaminated and other deteriorated areas in concrete with an approved patching material.

   Concrete may be treated with muriatic acid to remove laitance and other surface contamination.

   Rout or sawcut cracks over 1/16” (1.6mm) and the line where deck coating systems will be terminated.

   Apply sealant to all joints and routed cracks. Install sealant coves at all change of plane or projections through the deck where coating will be applied, such as curbs, walls rigidly connected slab intersections, posts, vents, pipes, stanchions and railings.

   Product safety information: Refer to container labels and material safety data sheets available from manufacturer for health and safety information.

   b. **Preparation**

   All surfaces must be clean and dry. Hairline cracks, blow holes less than 6mm diameter and minor steps shall be filled and skimmed. Larger blemishes shall made good to the Engineer's satisfaction with 1:5, cement:clean, sharp sand.

   In the case of an alternative coating material being approved, sealing, filling and skimming materials shall be as recommended by the manufacturer of that material.

   c. **Protection**

   Protect all adjacent surfaces, floors etc. from splashes of the materials being applied.
SPECIAL COATINGS (09800) (CONT'D)

G. Workmanship (Cont'd)

1. Coating (Cont'd)
   
d. Application of Finish

   Apply the background and heavy-spatter coat by brush, roller or spray gun entirely in accordance with the maker's instructions, finishing all perimeter edges with a 13mm brush margin. Any dilution of the material to achieve the required texture shall be with clean water and within the limits specified in the manufacturer's instructions.

2. Warranty

   Bind guarantee is available from the applicator against defects of materials and workmanship for a period of up to 5 years, beginning with the date of substantial completion of the deck coating system. Contact manufacturer for sample documents, including all limitations.

3. Maintenance

   Damaged surfaces shall be cleaned and have liquid coating material and aggregate applied to match surrounding surface. Surfaces shall be washed with non-phosphate commercial detergents or appropriate solvents. Badly soiled surfaces shall be steam cleaned without damage to the finished surface. Maintenance manual shall be provided to the Engineer.

4. Cleaning

   Wash all equipment and splashes with clean water as soon as possible and leave clean and tidy on completion.
PAINTING (09900)

A. **Scope**

1. This section includes the Site Painting of all interior and exterior items and surfaces throughout the project except as otherwise indicated or work having a natural specified finished surface. The term 'Painting' in this context covers all coating and finishing systems and their component or accessory materials whether used as prime, intermediate or finish coats, and this Specification includes the Site preparation of surfaces by cleaning, roughening, rubbing down, stopping and filling, or other preparatory process all as specified hereunder.

   All exposed items and surfaces shall be painted and all materials that require a protective coating shall be painted except where indicated on drawings or schedules as being unpainted, work having a natural specified finished surface, and work covered in the following paragraph.

   The work covers the painting and protection of all plant, apparatus, pipework and equipment installed under the Mechanical and Electrical Work.

B. **Performance and Standards**

1. All painting systems shall be entirely satisfactory in terms of compatibility of constituent to substrate, adhesion, coverage, colour-fastness and durability in the climatic and other conditions pertaining to the site within the limits of accepted good practice.

2. Work in this section shall comply with:

   BS CP 231  Painting of Buildings.
   BS CP 3012 Cleaning and Preparation of Metal Surfaces.
   BS 3900 Methods of Tests for Paints.
   BS 5493 Code and Steel Structures against corrosion.

3. All materials shall conform to applicable British Standards whether referred to in this Section or not.

C. **Related Items**

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Finishes</td>
<td>05030</td>
</tr>
<tr>
<td>Steel Doors</td>
<td>08110</td>
</tr>
<tr>
<td>Wood Doors</td>
<td>08210</td>
</tr>
<tr>
<td>Portland Cement Plaster</td>
<td>09220</td>
</tr>
<tr>
<td>External Render</td>
<td>09225</td>
</tr>
</tbody>
</table>
D. **Submittals**

1. **Manufacturer**
   
   The names, official addresses and technical brochures of the paint manufacturers, giving properties of materials, shall be submitted to the Engineer for clearance, prior to ordering.

2. **Manufacturer's Instructions**
   
   Provide the Engineer with copies of the manufacturer's application instructions and call his attention to any discrepancy between these instructions and the Specification. Obtain the written concurrence of the Engineer and manufacturer as appropriate to any proposed change in either Specification or manufacturer's instruction.

3. **Coordination**
   
   Ensure that the paint manufacturer is aware of and accepts the substrate to which his product is applied, in particular, to ensure compatibility, where the surface to be painted has already received a coating such as shop-applied primer. Provide barrier coats over incompatible primers or remove and reprime as required.

4. **Colour Samples**
   
   After selection but prior to application provide samples of each colour on cards 500 x 500mm and obtain the Engineer's approval thereof.

5. **Control Samples**
   
   Complete representative sample areas of each type of coating as directed by the Engineer, including preparation of surfaces. Obtain approval of appearance before proceeding. Provide, for the Engineer's inspection, lighting conditions such as those under which the work will normally be seen.

6. **Testing**
   
   Arrange for any tests called for by the Engineer to be carried out to determine compliance with the Specification, and submit the results of the tests to the Engineer.

   Permit coating manufacturers to inspect work in progress and to take samples of their products from Site if required. The results of any tests carried out by or on behalf of manufacturers shall be submitted to the Engineer.
PAINTING (09900) (CONT’D)

D. Submittals (Cont’d)

7. Certificates

The Contractor shall submit test certificates in respect of any fire-retardant coatings he proposes to use.

E. Product Handling

1. Delivery and Labeling

Coating materials and all materials used in painting shall be delivered to Site in sealed undamaged containers, clearly labeled with the following information:

a. Type of material.

b. Manufacturer's name, brand name, if any, and identification related to colour schedules.

c. Manufacturer's batch number and date of manufacture.

d. Contents by volume for major pigment and vehicle constituents.

e. Manufacturer's intended use.

f. Thinning and application instructions.

2. Order of Use

Batch deliveries of coating materials shall be dated for use in order of delivery which shall reflect the order of manufacturing dates.

3. Container Size

Paints other than water-based and bituminous paints shall be delivered in containers not exceeding 5 litres capacity.

4. Storage

Store materials in a clean, dry area protected from extreme temperatures. Keep storage space neat and accessible at all times. Protect floors from paint spillage. Discard and remove from Site any paints in containers which have received any but superficial damage.
E. **Product Handling (Cont'd)**

5. **Pre-Installation Protection of Mechanical and Electrical Equipment**

All ferrous apparatus and equipment shall be provided at the manufacturer's Works with a protective coat of primer paint to minimize corrosion prior to installation.

All bright, polished machined parts, chrome-plated or similarly finished components shall be wrapped with self-adhesive plastic which shall be retained on Site by the Contractor, until the equipment is commissioned. The Contractor shall then remove the wrapping, clean up and re-instate the original finish.

F. **Material**

1. **General**

Coating materials shall be obtained from one approved manufacturer only for each type of material. All coats from primer to finishing coat in a system shall be from the one manufacturer.

Painting materials for internal and external coating shall be as manufactured by "Berger", "Guittet", "ICI", "Wallglaze", "AM3" or approved equal.

2. **Filling, Stopping, Cleaning Materials**

   a. Paint strippers, abrasive papers and blocks, cleaning agents, etching solutions, mould inhibitors, rust inhibitors, size, stopping, knotting, fillers and other ancillary materials shall be the best of their respective kinds, used as recommended by their respective manufacturers and the decorative coating manufacturer for the surface being prepared, unless otherwise specified.

   b. White spirit shall be to BS 245.

   c. Knotting shall be to BS 1336.

   d. Stopping for woodwork to receive clear finish shall be tinted to match surrounding woodwork, to approval.

   e. Stopping for other internal work shall be plastic base, non shrinking.
PAINTING (09900) (CONT'D)

F. Material (Cont'd)

3. Gloss/Semi-Gloss Paint
   a. Long - oil based alkyd paint, undercoats and finishing coats to BS 2524.
   b. Polyurethane based paint, undercoat and finishing coat.
   c. Titanium Dioxide paint, undercoat and finishing coat.

4. Emulsion Paint
   Vinyl emulsion paint, matt and semi-gloss as directed by the Engineer. All emulsion paints shall be vinyl unless otherwise specified.

5. Emulsion Primer/Mist Coats
   Material shall be thinned strictly in accordance with manufacturer's instructions.

6. Wood Primer
   Acrylic.

7. Steel Primer
   a. Calcium plumbate to BS 3698.
   b. Zinc-rich primer.

8. Steel Primer for Mechanical Work
   Zinc chromate.

9. Galvanized Steel Primer
   2 pack etching primer.
PAINTING (09900) (CONT'D)

F. Material (Cont'd)

10. Bituminous Paint
    To BS 3416.

11. Anti-Alkaline Primer
    As recommended and manufactured by the manufacturer of follow-up coats

12. Lead Content
    Lead content in the pigment shall not be allowed.

13. Putty
    Putty to wood and cement surfaces shall comply with the following standards:

    ASTM  C.321-83 and D.2486-79
    BS     2750, sound reduction.
    BS     1191, 4551, 5270, 5492 and 6214 C and E.
    NF     T 30-606 and 30-608
    US Federal TT C-555, textured coating

    Putty material for wood surfaces, concrete and plaster surfaces shall be as manufactured by "alltek" or approved equal to the approval of the Engineer.
G. Workmanship

1. Preparation

A Generally

a. Prepare surfaces in accordance with decorative coating manufacturer's recommendations.

b. Remove ironmongery, electrical plates and fittings, etc., from surfaces to be decorated and refix on completion of decoration.

c. Use rust inhibitors, size, stopping, knotting and fillers in accordance with manufacturer's recommendations.

d. Ensure that all holes, cracks, defective joints and other defects in surfaces to be prepared and decorated have been made good so that they are not visible when decoration is completed.

e. Ensure that pre-primed surfaces have been properly prepared and that the primer is of a suitable type, firmly adhering and in good condition.

f. Before decorating allow surfaces to dry thoroughly.

g. Brush down all surfaces immediately before decorating to remove dust, dirt and loose material. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.

h. Apply three (3) coats of putty to concrete and plaster surfaces.
G. Workmanship (Cont’d)

1. Preparation (Cont'd)

B New Concrete, Block, Plaster and Render Surfaces

a. Remove release agents by washing with a weak detergent solution and rinse off with clean water.

b. Ensure that surface deposits and loose or flaking material are removed.

c. Efflorescence: Remove surface salts with a stiff brush or coarse dry cloth. Remove residue with a damp cloth frequently wrung out in clean water. Leave for 48 hours and repeat process if further efflorescence occurs. Sand or scrape glossy-surfaced hard bloom to provide a key for finish.

C New Iron and Steel Surfaces

a. Manual cleaning: chip, scrape and wire-brush surfaces to remove loose scale, welding slab and spatter. Clean out crevices. Remove oil, grease and dirt using white spirit, naphtha or steam.

b. Pre-primed surfaces: ensure that defective primer, rust and loose scare are removed back to bare metal, and patch primer to match existing. Remove dirt and grease from satisfactorily primed surfaces and rub down lightly.

D New Timber, Plywood, Chipboard, Fibre Board Surfaces

a. Moisture content: ensure that at time of decorating timber has a moisture content appropriate to its use.

b. Loose knots: ensure that large and dead knots are removed and made good with sound timber. Rub down flush before priming.

c. Smoothness: ensure that surfaces have a smooth, even finish with arises rounded or eased.

d. Nail and screw heads: ensure that heads are countersunk sufficiently to hold stopping. Ensure that pelleting is of full size, fills the whole of the recess and is securely fixed.
PAINTING (09900) (CONT'D)

G. Workmanship (Cont'd)

1. Preparation (Cont'd)

D New Timber, Plywood, Chipboard, Fibre Board Surfaces (Cont’d)

  e. Stopping for painting: after priming, stop nail and screw holes and similar depressions with stopping pressed well in. Finish off brush with surface.

  f. Stopping for clear coatings: stop nail and screw holes and similar depressions with stopping to match colour of timber, pressed well in. Finish off flush with surface.

  g. Knotting: remove resinous exudations and apply knotting to resinous timber and all knots and allow to dry.

  h. Degreasing: wash down with white spirit immediately before priming hardwoods containing an excess of natural oil. Clean off surface oils from building boards with white spirit and roughen surface with fine abrasive paper. Dust of surface before decorating.

  j. Filling: after priming or sealing and stopping, fill pore and grain irregularities with filler, brush or knife applied. Remove surplus and rub down to leave a smooth, even surface.

  k. Pre-primed surface: ensure that any areas of defective primer are removed and patch-primed to match existing. Remove dirt and grease from satisfactory primed surfaces and rub down lightly.

E Miscellaneous New Surfaces

  a. Plastic Surfaces: wash down with soap and water or detergent solution to remove dirt and grease and while wet lightly abrade with fine abrasive paper. Rinse off with clean water.
PAINTING (09900) (CONT'D)

G. Workmanship (Cont'd)

2. Coating Materials

A Generally

a. Prepare surfaces for decoration as specified in G1 above.

b. Where surfaces have been treated with preservatives, check with treatment manufacturer that coating materials are compatible with the treatment.

c. Cleanliness:

   Keep all brushes, tools and equipment in clean condition. Keep all surfaces clean and free from dust during coating and drying.

d. Provide suitable receptacle for liquids, slop washings, etc.

B Precautions and Protection

a. Place paint or solvent soaked rags, waste or other materials which might constitute a fire hazard in metal containers and remove from premises at close of day's work. Take every precaution to avoid damage by fire.

b. Protect freshly applied coatings from damage.

c. Exhibit 'Wet Paint' signs and provide protection barriers where necessary.

d. Protect adjacent surfaces adequately.

e. Protect cordage, seals and the like from contamination by paint. Remove any paint that does get on by appropriate solvent.

f. Remove ironmongery and other fittings as in G 1.01 (b)above. Items which must remain in position during painting must be adequately and carefully taped.
G. Workmanship (Cont'd)

2. Coating Materials (Cont'd)

C Preparation of Materials

a. Generally. Prepare coating materials as recommended by their manufacturers.

b. Strain through fine gauze any coating materials showing bittiness in application.

c. Do not intermix different coating materials.

d. Stir coating materials to attain an even consistency before use unless otherwise recommended by manufacturers.

D Application

a. Carry out decoration in colour as selected by the Engineer and in accordance with approved samples.

b. Generally: apply coatings in accordance with their manufacturer's recommendations to clean, dry surfaces in dry dust free atmospheric coats have hardened.

c. Covering capacity: the Contractor is to allow for quantities of paint necessary to give proper cover in the number of coats specified and in accordance with the nature of the material to which it is to be applied.

d. Unsuitable conditions: don not apply coatings:

   i. To surfaces affected by moisture or frost.

   ii. When ambient temperature is below 4 degrees C.

   iii. When heat is likely to cause blistering or wrinkling.

e. Priming Generally:

   i. Apply priming coats by brush unless other methods are approved.

   ii. Work primer into surface, joints, angles and end grain.
PAINTING (09900) (CONT'D)

G.  Workmanship (Cont'd)

2.  Coating Materials (Cont'd)

D  Application (Cont'd)

  e.  (Cont'd)

    iii.  Ensure that priming coats are of adequate thickness and suit surface porosity.

    iv.  Ensure that any primed surfaces which have deteriorated on Site or in transit are touched up or re-primed.

  f.  Concealed joinery surfaces: apply priming coat to all concealed surfaces of built in joinery components before fixing.

  g.  Priming metal: prime metal surfaces on same day as they have been cleaned.

  h.  Undercoats: apply an even film over all exposed surfaces, avoiding uneven thickness at edges and angles.

  j.  Finishing coats: apply an even film over all exposed surfaces, avoiding brush marks, sags, runs and other defects.

  k.  Rub down all priming and undercoats to a smooth surface with abrasive paper and remove all dust before applying the next coat.

  l.  Cut in neatly and cleanly. Do not splash or mark adjacent surfaces.

  m.  Brush Painting:

    i.  Apply all paints by brush unless otherwise specified.

    ii.  Lay off all areas evenly and ensure that finished surfaces are free from brush marks.

  n.  Roller painting will be permitted in the application of emulsion paint.

  p.  Spray painting will be permitted in the application of emulsion paint.

  q.  Spray Painting: mask all adjoining surfaces.

  r.  Cleaning: clean off any paint spots or spillage from adjacent surfaces as the work proceeds without damage to that surface.
H. **Schedule of Interior Painting**

1. Paint interior surfaces exposed to view in accordance with this Schedule of Interior Painting, except as specifically shown or specified. For number of coats refer to Bills of Quantities.

2. **Ferrous Metal**
   a. **Shop-Primed**
      i. Undercoat: Spray Enamel Undercoater
      ii. Putty
      iii. Finishing Coats: Spray Alkyd Eggshell Enamel

   b. **Galvanized**
      i. Prime Coat: Spray Zinc Dust Primer
      ii. Putty
      iii. Undercoat: Spray Enamel Undercoater
      iv. Finishing Coats: Spray Alkyd Eggshell Enamel

3. **Plaster**
   a. **Enamel Finish**
      i. Prime Coat: Latex Primer
      ii. Putty
      iii. Undercoat: Enamel Undercoater
      iv. Finishing Coats: Alkyd Eggshell Enamel

   b. **Flat Finish**
      i. Prime Coat: Latex Primer
      ii. Putty
      iii. Undercoat: Latex Undercoater
      iv. Finishing Coats: Latex Flat
PAINTING (09900) (CONT'D)

H. Schedule of Interior Painting (Cont'd)

4. Wood

a. Shop-Primed
   i. Undercoat: Enamel Undercoater
   ii. Finishing Coats: Varnish

b. Plywood and Softwood
   i. Prime Coat: Alkyd Primer Sealer
   ii. Putty
   iii. Undercoat: Enamel Undercoater
   iv. Finishing Coats: Alkyd Eggshell Enamel
DIVISION 10

SPECIALTIES

FLAGPOLES (10350)

A Summary

Sections include sign flag supports and accessories.

Related Sections:
Section 05500 Metal Fabrication

B References


C Performance Requirements

Flagpole Without Flag: Resistant without permanent deformation to 120 km/hr wind velocity; non-resonant, safety design factor of 2.5.

D Submittals

Section 01300 - Submittal Procedures

Shop Drawings: Indicate detailed dimensions, details, anchor requirements, and imposed loads.

Product Data: Submit data on pole, accessories, and configurations.

E Closeout Submittals

Section 01700 - Contract Closeout.

Operation and Maintenance Data: Submit Operation and Maintenance Data.

F Delivery, Storage, And Handling

Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

Protect flagpole and accessories from damage or moisture.
FLAGPOLES (10350) (CONT’D)

G. **Products**

1. **Sign Flag Supports**

   Shall be stainless steel pipes inclusive of flanges, supports, plates and caps as detailed on drawings and as indicated in Bill Items.

   Furnish and install elements to dimensions and details shown on drawings.

   Stainless steel shall be to ASTM A312, TP304 grade.

2. **Canvas**

   Canvas for sign shall be serie S1601 Linen-white (Serge 2165) as manufactured by Helioscreen or approved equal.

   a. **Technical Data**

      **Yarn**

      | Titer | ISO 1889 | 165 tex ± 5 tex |
      |-------|----------|----------------|

      | Weighted Composition | ISO 3801 | Glass |
      | 41.5 ± 1.5% | PVC 58.5 ± 1.5% |

      | Diameter | 0.38mm ±0.02mm |

      | Environment | Oekotex standard 100 |

      **Fabric**

      | Thickness in mm | ISO DIS 508 | 0.83 ± 0.05mm |

      | Yarns In Warp/weft/cm | ISO 7211 | 18/14 ± 0.5 |

      | Weakness point | ISO 458/2 (Test Clash & Berg) | 25°C |

      | Air porosity | NFG07-111 | 2200 l/m²/sec |

      | Breaking strength | ISO 5081 | Warp 270 daN ±5% |
      |                  |        | Weft 240 daN =3% |
FLAGPOLES (10350) (CONT'D)

G. **Products (Cont'd)**

2. **Canvas (Cont'd)**

   a. **Technical Data (Cont'd)**

      | Property                     | ISO   | Value               |
      |-------------------------------|-------|---------------------|
      | Elongation at break           | 5081  | Warp 5.6%±0.3       |
      |                               |       | Weft 5%±0.3         |
      | Tear Resistance               | 4674  | Warp 17 daN ±5%     |
      |                               |       | Weft 19 daN =5%     |
      | Colourfastness                | 105-82| 7-8                 |
      |                               |       | (Artificial light Xenon arc lamp) Scale of blue |
      | UV-Resistance                 | 105-82| Min 4               |
      |                               |       | (Artificial light Xenon arc lamp) Scale of grey 1.5 |
      | Shading coefficient           | ASHRAE| From 0.10 to 0.16   |

   b. **Solar, Heat, and Light Control Properties**

      | Property                     | Front | Back  |
      |-------------------------------|-------|-------|
      | Solar transmittance           | 12%   | 12%   |
      | Solar reflectance             | 55%   | 58%   |
      | Solar absorption              | 33%   | 30%   |
      | Visible light transmittance   | 9%    | 9%    |
      | Openness factor               | 4%    | 3%    |
      | UV transmittance              | 4%    | 3%    |
FLAGPOLES (10350) (CONT'D)

H.  Execution

1.  Examination

   Verify wall supports are ready to receive work and dimensions are as indicated on shop drawings

2.  Installation

   Set brackets for wall set flagpoles anchored securely into wall construction

   Maximum Variation From Plumb:  25 mm.
SIGNAGE (10400)

A. **Scope**

The work of this section shall include, but not be limited to, the installation of interior and exterior directional and information signage.

B. **Performance and Standards**

Materials and work shall conform to the latest edition of reference specifications specified herein and to applicable codes and standards.

C. **Related Items**

09800 Special Coatings
09900 Painting

D. **Submittals**

1. **Product Data**

Submit copies of manufacturer’s latest published literature for materials specified herein for approval, and obtain approval before materials are fabricated and delivered to the site.

3. **Samples**

Samples of materials specified herein and shall be submitted for approval, and approval obtained before materials are delivered to the site.

E. **Product Handling**

1. Exercise proper care in the handling of work so as not to injure the finished surfaces, and take proper precautions to protect the work from damage after it is in place.

2. Deliver materials to the job site ready for use. Assemblies shall be identical to submitted and reviewed shop drawings, samples and certificates.

3. Store materials under cover in a dry and clean location off the ground. Remove materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials at no additional cost.
SIGNAGE (10400) (CONT'D)

F. **Materials**

1. **Manufacturers**

   Signs specified herein and indicated on the drawings shall be manufactured by an approved manufacturer.

2. **Materials**

   **Accessories:** Manufacturer’s standard anchors, fasteners, set screws, spacers and other accessories compatible with material in contact, as indicated or required for complete installations.

   **Building Signs**

   a. **Aluminium**

      i. Aluminium plate, angles, channels, extrusions and other structural items shall be fabricated from alloy 6061-T6, 6063-T5 or other alloy as required for applicable function and use.

      ii. All aluminium shall be of the best commercial quality and their various forms shall be straight and true. There shall be no scratches, scards, creases or buckles.

      iii. Welded joints shall be heliarc welded in conformance with the American Welding Society and the Aluminium Associations specifications.

   b. **Steel**

      i. Structural steel sections, channels, tubing and angles shall meet the requirements of ASTM A-36, with prime paint coating.

   c. **Fasteners and Hardware**

      i. Hardware shall be non-corrosive type and shall be non-conductive and/or insulated when joining non compatible material. Paint for shop coating and field touch-up of dissimilar metal connecting members, including anchors and clips, shall be alkali-resistant, bituminous paint.
SIGNAGE (10400) (CONT'D)

F. Materials (Cont'd)

2. Materials (Cont'd)

Building Signs (Cont'd)

d. Acrylic Plastic

Provide cast (not-extruded) methacrylate plastic sheet with a minimum allowable continuous services temperature of 180 degrees F; in sizes and thicknesses indicated; and in the following general types:

i. Where indicated as "translucent" provided coloured translucent acrylic sheet in colours and finishes indicated.

e. All adhesive and adhesive tapes required for plastic, glass and metal shall be a type recommended for the particular usage by 3M manufacturer and guaranteed to meet the general and structural support criteria shown on the drawings. Tapes and fastener division. All adhesives and tapes must be guaranteed by manufacturer.

f. Electrical Components

i. Fluorescent lamps shall be T-12 high output lamps with low temperature ballast rated for -20 degrees F.

ii. Neon shall be clear red 12mm or 15mm for best illumination. Transformers shall be 30ma or as required by local code.

iii. Provide photocell for each illuminated sign, mounted as detailed.

iv. Wiring shall be THHW and shall conform to all applicable building codes.

v. Concealed disconnect switches shall be provided at all illuminated signs where the electrical service centers the sign unit, immediately accessible upon servicing the sign.

vi. All signs must conform to NEC code.
F. **Materials (Cont'd)**

2. **Building Signs (Cont'd)**

  g. **Paint**

  i. All painted surfaces on aluminium to be Matthews polyurethane (2) part system. Compliance to VOC laws is required. NO SUBSTITUTION.

  ii. All paints shall be evenly applied and without pinholes, scratches, orange peeling or application marks. Workmanship in connection with finishes shall conform to the standards of the trade.

  iii. Prime coats or other surface pre-treatments, where recommended by the manufacturer for paints, shall be included in the work as part of the finish surface work.

  h. **Vinyl Die-Cut Letters**

  i. All legends, arrows and logo types on non-illuminated signs, unless otherwise noted, shall be precision die-cut from "Scotchcal" brand Series 3630 (colours as designated) sheeting as manufactured by 3M company, shall be free of trapped air bubbles, wrinkles and tears. All copy shall be applied straight and true with proper inter-letter and inter-work spacing. burgundy - 3630-49. Light Beige - 3630-149. Blue - 3630-157.

  i. **Fabrication**

  i. Fabricate panel signs to comply with requirements indicated for materials, thicknesses, finishes, colours, designs, shapes, size and details of construction.

  ii. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally corner to corner.

  iii. Fabricate brackets and fittings for bracket-mounted signs from extruded aluminium to suit sign panel construction and mounting conditions indicated. Factory paint brackets in colour matching background colour of sign panel, unless otherwise indicated.
SIGNAGE (10400) (CONT'D)

F. **Materials (Cont'd)**

2. **Materials (Cont'd)**

**Building Signs (Cont'd)**

i. **Fabrication (Cont'd)**

   iv. **Graphic image process:** provide sign to comply with requirements indicated for sizes, styles, spacings, content, positions, materials, finishes and colours of letters, numbers, symbols and other graphic devices.

j. **Finishes**

   i. For exposed sign materials which require selection of materials with integral or applied colours, surface textures or other characteristics related to appearance, provide colour matches indicated.

   ii. Surfaces exposed to exterior and interior view shall be coated with Matthews acrylic polyurethane enamel.

   iii. All paint finishes to be baked after top coated, approximately 2 hours after painted to assure the utmost adhesion and ease of handling after baking all metal parts.

k. **Exterior Non-illuminated signs (directional signs)**

   i. Die-cut 3M opaque copy on acrylic urethane enamel background in size, letter style and letter spacing shown. Copy shall be permanently applied to panel face.

   ii. Panels shall be fabricated from two flanged edge, 080 aluminium panels nested together to form a double sided hollow panel. Panels shall be horizontally and vertically reinforced along center lines of panel span with concealed structural members. Panels shall receive acrylic urethane finish.

   iii. Casing members shall be aluminium extrusion members with aluminium tube supports as shown on drawings. No visible fasteners are permitted. Welded joints shall be ground smooth to finish flush with aligning metal surfaces. Frame and support to receive a top coat of Matthew polyurethane (2) part paint.
SIGNAGE (10400) (CONT'D)

F. **Materials (Cont'd)**

2. **Materials (Cont'd)**

**Building Signs (Cont'd)**

i. **Exterior Signs Internally illuminated**

   i. Illuminated copy shall be negative reading, internally illuminated as required for even distribution of light through graphics without hot spots. Intensity of light shall provide adequate copy legibility in areas with high ambient lighting levels. Excessively high levels of illumination causing irradiation effect of other legibility impairment will not be accepted.

   ii. Where identified on the Drawings, signs shall be internally illuminated, copy both sides as required. Unless noted otherwise, signs shall be illuminated with T-12 high output fluorescent lamps with low temperature ballast, 120 volt. Rubber water rings required. UL listed with concealed fused disconnect switch immediately accessible upon service access.

   iii. Face material on all pylons, wall signs to be 3M panaflex 945GPS graphics are to be white (substrate) and background colour is to be heat transferred. 3M-Paint on paper #830-49A (burgundy), #830-157 (Sultan blue), and #830-149 (light Beige). Entire surface to be top coated with #840-114 Clear Coat.

   iv. Structure of sign shall meet all local, national and applicable codes that apply.

   v. Signs shall be internally illuminated with high output fluorescent lamps. Photocell for control of light and fused disconnect switch will be furnished and installed. Disconnect shall be immediately accessible upon service access.
SIGNAGE (10400) (CONT'D)

F. **Materials (Cont'd)**

2. **Materials (Cont'd)**

**Building Signs (Cont'd)**

m. **Exterior Signs Internally illuminated letters**

i. Fabricate letters to required sizes and styles, using metals and thicknesses indicated. Form exposed faces and sides of characters to produce surfaces free from warp and distortion, include internal bracing for stability and attachment of mounting accessories as required.

   a) Aluminium sheet: Not less than .063 thick. Fabricate by heliare welding process.

   b) Illuminated units: Illuminated units in manner indicated on drawings including neon tubes, transformers, insulators, with provisions for servicing and concealed connection to building system. NOTE: All transformers are to be of the PBKM type. Straight 'P' type transformers are not acceptable. Coordinate electrical characteristics of signs with the power supply provided.

n. **Installation**

i. Locate signs units and accessories where indicated, using mounting methods of type described on drawings.

ii. Install sign units level, plumb and at height indicated, with surfaces free from distortion or other defects of appearance.

iii. Mount letters as follows: Use standard fastening methods recommended by manufacturer for letter form, type of mounting, wall construction and construction and condition of exposure indicated. Provide heavy weight paper template to establish letter spacing and to located holes for fasteners.

iv. Flush mounting: mount letters with backs in contact with wall surface.

v. Projected mounting: Mount letters at projection distance from wall surface indicated.
SIGNAGE (10400) (CONT'D)

G. Workmanship

1. Examination
   a. Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

2. Preparation
   a. Examine the Contract Drawings and Specifications in order to insure the completeness of the work required under this Section.
   b. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades.
   c. Provide templates as required to related trade for location of support and anchorage items.

3. Installation
   a. In addition to requirements of these specifications, comply with manufacturer’s instructions recommendations for phases of work, including preparation of substrate, applying materials, and protection of installed units.
   b. Provide anchorage devices and fasteners where necessary for securing interior signs to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete. Provide fasteners of metal, type, and size to suit type of construction indicated.

4. Cleaning and Protection
   a. Do not remove strippable protective material until finish work in adjacent areas is complete. When protective material is removed, clean exposed metal surfaces to comply with manufacturer’s instructions.
CONTROL DEVICES (10450)

A. **Scope**

Work includes, but is not limited to arm barrier, electrically operated.

B. **Performance and Standards**

Comply with applicable codes and regulations and to the direction of the Architect.

C. **Related Items**

- Metal Fabrications 05500
- Painting 09900

D. **Submittals**

Submit Shop Drawings on work specified to be provided under this section. Shop Drawings shall show all details necessary for fabrication and installation, including sizes and spacing of members and connections, finishes and relationships with adjacent surfaces.

E. **Product Handling**

Check materials on arrival for shipping damage.

F. **Materials**

1. Materials shall be of adequate strength and suitable for use intended, and shall be non-staining and non-corrosive.

2. Parking arm barrier shall be suitable for fast crossings up to 5m, equipped with D.C. motor with speed-regulating device, slow-down device in opening and closing, and amperometric sensor for obstacle detection. It shall be ready for the installation of buffer batteries and should be equipped with release device.
CONTROL DEVICES (10450) (CONT'D)

F.  Materials (Cont'd)

3. Technical Data

Leed: V.A.C 230
Aliment. Maleut: V D.C. 24
Motor rating: W190
Motor absorption: A12
Torque: Nm 210
Reduction ratio: 0.005
Insulation class: Y
Working temp.: -20°/+70°C
Opening time: sec. 2:7
Lubrication: grasso permanente
Weight: kg. 61

4. Parking arm barrier shall be Vega serie as manufactured by Beninca, or approved equal.

G.  Workmanship

1. Fabrication shall be in accordance with approved Shop Drawings.

2. All metal assemblies shall have welds ground smooth, and shall be hot-dip galvanized after fabrication, phosphate treated to promote paint adhesion and shop primed for field painting.

3. Condition of Surfaces: Verify existing conditions and dimensions in field before beginning installation.

4. Preparation: Coordinate installation of anchor bolts at reinforced concrete base to accommodate the barrier.

5. Installation of barrier shall be carried out according to the manufacturer's instructions.

6. Protection: Protect site improvements from damage.

7. Patching: Touch-up bolted connections and abraded areas of shop paint with same material as that originally used.
WINDOW WASHING SYSTEMS (10700)

A. **Scope**

The work of this section shall include, but not be limited to, the installation of window washing systems with all related works as shown on the drawings and as specified herein.

B. **Quality Assurance**

1. Manufacturer Qualifications: An established and reputable firm with minimum five years production of power scaffolding of quality and scope required for this Project.

   a. Manufacturer must be able to show he has experienced personnel, physical facilities, established quality control procedures, management capability sufficient to produce system without causing Project delay.

   b. Right is reserved to require manufacturer to submit list if at least three representative systems three years old or older, with date of installation and architect's and builder's names and addresses.

2. Qualifications:

   a. Erector: Regularly engaged for at least five years in erection of power scaffold systems similar to this Project.

   b. Welder: Present evidence, in compliance with AWS D1.1, that each welder has satisfactorily passed qualification tests for welding has not welded for more than six months. Submit for Design Consultant's information only.

3. Quality Control: Contractor to establish and maintain quality control to assure compliance with contract requirements.

   a. Maintain records of his quality control for all construction operations required under this Section. Furnish copy of these records, as well as corrective action taken, to Owner at time of Owner's acceptance.

   b. Records to Include:

      1. Load test of typical davit base to minimum of 4 times rated loads.
      2. Certified load test of typical davit to minimum of 4 times rated load.
      3. Welder AWS Certification.

   c. Provide Owner's personnel instruction on operation and maintenance of window washing equipment.

All equipment consisting of momorail, wire ropes, cradles and other accessories shall be from a single source.
B. **Quality Assurance (Cont'd)**

4. Design Criteria: Federal, state and local codes and requirements shall be ascertained by the supplier. Where requirements of governing codes, regulations, laws, and rules promulgated by authorities having jurisdiction conflict with these Specifications and are mandatory, they shall be followed the same as if specified herein. Design structures with safety factor of 4 to 1 or greater on overturn. Provide design stamped by registered Engineer for approval.

C. **Related Items**

05010 Metal First Fixing Materials
05030 Metal Finishes
05500 Metal Fabrications
09900 Painting

D. **Submittals**

1. General: In compliance with section 01300 and as specified herein.

2. Shop Drawings: Detailed drawings showing all components of davits and coupling settings.
   
   a. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
   
   b. Show assembly, including parapet and layout of roof top system.

3. Product Data: Manufacturer's installation instructions and recommendations.

4. Certificates: Load test of typical davit as specified in Subparagraph 1.01.C.2 herein. All required submittal of items specified to be certified except for:
   
   a. Shop Drawings.
   
   b. Operations and maintenance procedures.
   
   c. Load, weights, and dimensions.
   
   d. Location of sockets for safest operation.

5. Operation and Maintenance Data: In compliance with Section 01700; including parts list and operating and maintenance data.
E. **Product Handling**

1. Exercise proper care in the handling of work so as not to injure the finished surfaces, and take proper precautions to protect the work from damage after it is in place.

2. Deliver materials to the job site ready for use. Assemblies shall be identical to submitted and reviewed shop drawings, samples and certificates.

3. Store materials under cover in a dry and clean location off the ground. Remove materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials at no additional cost.

F. **Materials**

1. Acceptable Manufacturers:

   TRACTEL S.A.
   or approved equal.

**Monorail**

The Monorail is an extruded aluminium dumbbell shaped profile with the following characteristics:

- **Size:** 120 x 40mm
- **Weight:** 6.05kgs/metre
- **Limit of elasticity:** 160MPa
- **Breaking strain:** 190MPa
- **Standard elasticity:** E= 69 500 MPa
- **Section:** S= 22.4cm²
- **Intria:** Lxx = 276cm  Lyy = 34.3cm
  - Wxx = 46cm³  Wyy = 16.5cm³

The profile is powder coated for protection against corrosion and to offer the Client the desired finish.
F. Materials (Cont'd)

1. (Cont'd)

**Connection**

The standard rail length is 5.8m and connection between two rails should be by 2 aluminium rods, 30 diameter x 245mm.

The rods are fixed by pins on opposite ends.

This ensures sufficient movement to allow for expansion.

The rail is connected to the building by hot dip galvanized and painted steel brackets, fixed to the inside of the parapet.

The Contractor should ensure the parapet is capable of sustaining the loads imposed.

**Traversing Trolley**

The powered trolley should have a completely enclosed geared motor with brake, with a level of protection IP54, Class F insulation, suitable for use in tropical conditions.

Controls by push button pendant and weight not exceeding 24 kgs.

**Cradle**

The cradle should be suitable for the purpose of cleaning all areas and must be powered using a traction hoist. Friction and drum hoists will not be accepted.

The cradle will house all the necessary gear, including wire rope reellers, central control box, container for electric cable, safety devices, etc…

Following guidelines to be enforced:

- Safe working load: 120 kgs
- Cradle size: 1000 x 660mm
- Lifting height: to suit building
- Safety devices:
  - Overload switch
  - Overspeed device
  - Emergency descent
  - Upper limit switch
  - Lower limit switch
  - Emergency stop
F. **Materials (Cont'd)**

1. **Monorail for Canopy Areas**

   Due to the projected canopy, the monorail required for this area must be a box section profile, housed within a slot on the underside of the canopy.

   The Contractor must ensure that the canopy support structure is capable of supporting the track and any associated loads imposed by the cradle.

   The monorail profile has the following characteristics:

   - **Size:** 100 x 80 x 5mm
   - **Material:** High tensile steel
   - **Finish:** Hot dip galvanisation + Paint
   - **Weight:** 11.3kg/meter.

2. **Materials And Accessory Materials**

   a. Fix galvanized steel channels of sufficient size to ceiling of space provided for cradle as shown on the drawings.

   b. All Non-Exposed Structural Components Galvanized Mild Steel: Conforming to BS 4 and ASTM A36, Type 350W with yield strengths of 50 Ksi for HSS and 43 Ksi for plate and all other sections.

   c. Galvanizing: Conforming to BS 729 and ASTM A123.

   d. Cold Rolled Sections: BS 5950, part 5 and DD EN 410220 and ASTM A500-84, with yield strength of 55 Ksi, tensile strength of 66 Ksi.
WINDOW WASHING SYSTEMS (10700) (CONT'D)

G. Workmanship

1. Installation

Install assembly in strict compliance with manufacturer's instructions and approved shop drawings.

Provide anchor bolt setting plans, templates and anchor bolts sufficiently in advance of concrete placement so as not to impede progress of Work. Templates shall be secure in place to preclude misplacements of anchor bolts, and bolts shall be installed at location and with projections established by approved structural steel drawings.

   a. No tack welding of any material to anchor bolts will be permitted.

Galvanizing: Hot-dip galvanize all steel members.

   a. Hot-dip galvanize members after fabrication in compliance with BS 729 and ASTM A123.


Set base plates as schedule herein and indicated in Drawings. Set level, using steel shims. Grout base plates with high strength nonshrink grout. Tighten anchor bolts after coupling settings have coupling settings have been positioned and plumbed.
DIVISION 15

MECHANICAL GENERAL PROVISIONS
SECTION 15.01 VALVES

15.01.1 - GENERAL

15.01.1.1 RELATED DOCUMENTS

A. Drawings, BOQ and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

15.01.1.2 SUMMARY

A. This Section includes general duty valves common to mechanical pumping systems.

15.01.1.3 SUBMITTALS

A. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application. Address at which the valves will be fabricated and assembled.

B. Valves similar to those proposed for use shall have been in successful service for a minimum of 10 years.

C. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing. Provide a list of all spares and replacement parts and location where they are available.

D. Provide material compliance sheet for the submitted valves

E. Provide certified hydrostatic test data per manufacturer’s standard procedure.

F. All valves shall be identified by a unique valve tag as identified in the valve schedule prepared by the contractor. The contractor shall identify each valve by its assigned tag number on all shop drawings and equipment submittal.

15.01.1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping, or equivalent European or American Norms.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.
C. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate Standards, including certified results of required tests and certification of proper installation.

D. All units of the same type shall be the product of one manufacturer.

15.01.1.5 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use hand wheels and stems as lifting or rigging points.

15.01.2 - PRODUCTS

15.01.2.1 BASIC, COMMON FEATURES
A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Internal and external parts of all cast-iron and ductile-iron valves installed underground and or exposed to outdoors shall be factory coated with 300 micron fusion bonded epoxy coating, or equivalent material
1. Valves installed above ground and indoors: apply epoxy coating for internal and external parts.

C. Sizes: Same size as upstream pipe, unless otherwise indicated. Valves specified are according to the American standards, substitution with the equivalent DIN, EN or ISO is acceptable. Pipes flanges and threading are in most cases not directionally compatible and mixing two standards is not recommended. Drilling out for bolt holes in the valve flange is not acceptable.

D. Operators: Use specified operators and hand wheels, except provide the following special operator features:
1. Hand wheels: For valves other than quarter turn.
2. Lever Handles: For quarter-turn valves DN150 (6 inches) and smaller.
3. Chain-Wheel Operators: For valves higher than DN100 (4 inches) and larger, installed 2400 mm (96 inches) or higher above finished floor elevation.
4. Gear-Drive Operators: For quarter-turn valves DN200 (8 inches) and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. Threads: ASME B1.20.1.

H. Flanges: EN 1092 for steel valves.

I. All valves shall be in an accessible location. If not, suitable means of access shall be provided.

15.01.2.2 GATE VALVES

A. Gate Valves, DN50 (2-1/2 Inches) and Smaller: EN 558-1.14; Steel body and bonnet, or EPDM lined solid-bronze wedge, copper-Stainless steel rising stem, mechanical packing, threaded connections; and with aluminum or malleable-iron hand wheel.

B. Gate Valves, DN65 (3 Inches) and Larger: EN 558-1.14; Steel body and bonnet, EDPM lined solid cast-iron wedge, Stainless steel stem, outside screw and yoke, mechanical packing, flanged end connections; and with cast-iron hand wheel.

C. Manufacturer: Crane, Econosto or approved equal.

15.01.2.3 BALL VALVES

A. Ball Valves, DN50 (2 Inches) and Smaller: MSS SP-110, PN 40 CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for DN15 (1/2-inch) valves and smaller and conventional port for DN20 (3/4-inch) valves and larger; blowout proof; bronze or brass stem; Teflon seats and seals; threaded connections:

2. Manufacturer: Crane, Econosto or approved equal.

15.01.2.4 BUTTERFLY VALVES

A. Butterfly Valves: BS-Standard 2789-73GR, 500/7, DIN Standard 1693 GGG 50 ductile iron body and bonnet, extended neck, stainless-steel stem, field-replaceable
EPDM sleeve and stem seals, flanged, lug, or grooved style:

1. Disc Type: Epoxy-coated ductile iron, EPDM lined.
2. Operator for Sizes DN50 (2 Inches) to DN 150 (6 Inches): Standard lever handle, with latch lock.
3. Operator for Sizes DN200 (8 Inches) to DN600 (24 Inches): Gear operator with position indicator.
4. Operator for Sizes DN250 (10 Inches) and Larger, 2400 mm (96 Inches) or Higher above Floor: Chain-wheel operator.
5. Manufacturer: Crane, Econosto or approved equal.

15.01.2.5 CHECK VALVES

A. Dual plate Wafer Type Check Valves, DN65 and above (2-1/2 Inches): ASTM A216 WCB; PN40; Steel body, EPDM seal, spring and shaft material stainless steel SS 316, wafer style inserted between mating flanges with studs spanning entire length.

B. Manufacturer: Crane, Econosto or approved equal.

15.01.3 - EXECUTION

15.01.3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion.

Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

15.01.3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe. Butterfly valves on horizontal shall be installed with the valve stem in the horizontal position.

F. Install valves in a position to allow full stem movement.

G. For chain-wheel operators, extend chains to 1500 mm above finished floor elevation.

15.01.3.3 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

15.01.3.4 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

15.01.3.5 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty. Refer to the Drawings also for the requirement of the type of the valve.

15.01.3.6 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.
SECTION 15.02 FLOW DEVICES

15.02.1 GENERAL

15.02.1.01 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for the flow related instruments.

15.02.1.02 RELATED WORK

A. Refer to Section 8.

15.02.1.02 ACCESSORIES

A. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.

B. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

15.02.1.03 APPROVALS/CERTIFICATIONS

A. Instruments specified herein shall meet at a minimum, the National Electrical Manufacturers Association (NEMA) rating for non-hazardous locations listed with each instrument.

15.02.1.04 SUBMITTALS

A. Refer to Section 1300.

15.02.1.04 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)

B. Factory Mutual (FM)

C. International Organization for Standardization (ISO)

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

15.02.1.05 QUALITY ASSURANCE

All materials shall be new.
15.02.2 PRODUCTS

15.02.2.01 TRANSIT TIME ELECTROMAGNATIC FLOWMETER (EXTERNALLY MOUNTED SENSOR)

A. Flow Element

1. Electromagnetic flowmeter shall be with manufacturer recommended surge protection as per the following specifications:

2. Measure value error: 0.3% of rate;


4. Nominal pressure: PN 80;

5. Lining: PTFE or elastomer,

6. Electrodes: Stainless steel,

7. Pressure Equipment Directive 97/23/EC, Transmitter Power supply: AC 100 ... 230 V (-15 / +10%), AC 24 V (-30 / +10%), DC 24 V (-30 / +30%)

B. Transmitter

1. Transmitter Housing: Integral mount design, choice of single-compartment housing or dual- compartment housing.

C. Manufacturer:

1. ABB Watermaster, GF Signet transmitter or approved equal.
SECTION 15.03 GAUGES

15.03.1 - GENERAL

15.03.1.1 SUMMARY
A. This Section includes gauges for mechanical systems

15.03.1.2 SUBMITTALS
A. Product Data: Include scale range, ratings for each gauge, fitting, specialty, and accessory specified. B. Shop Drawings: Include schedule indicating scale range, fittings, and location for each gauge.

15.03.1.3 QUALITY ASSURANCE
A. Comply with applicable portions of ASME and ISA standards or approved equal pertaining to construction and installation of meters and gauges. B. Uniformity/standardization of meters and gauges furnished, of a single manufacturer, shall be maintained throughout the facilities.

15.03.2 - PRODUCTS

15.03.2.1 PRESSURE GAUGES
A. Description: ASME B40.1, phosphor-bronze Bourdon tube type with bottom connection; Stainless steel rack and pinion movement. The Gauges shall be glycerin filled. Gauges shall be calibrated from 0-5 Bar on the suction side and from 0-50 bars on the discharge side. Gauges shall be 4 ½” diameters with ¼” inlet.
B. Connector: Brass, DN8.
C. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.
D. Manufacturer: Wika (Type 211.11), Ashcroft (Type 1009) or approved equal.
15.03.3 - EXECUTION

15.03.3.1 GAUGE INSTALLATION, GENERAL
A. Install gauges, and accessories according to manufacturer's written instructions for applications where used

15.03.3.2 PRESSURE-GAUGE INSTALLATION
A. Install pressure gauges in piping tees with isolating valve located on pipe at most readable position.
B. Install liquid-filled-type pressure gauges at suction and discharge of each pump.

15.03.3.3 ADJUSTING AND CLEANING
A. Adjust faces of gauges to proper angle for best visibility.
SECTION 15.04 CENTRIFUGAL END-SUCTION PUMPS

15.04.1 - GENERAL

15.04.1.1 RELATED DOCUMENTS

A. Drawings, BOQ and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

15.04.1.2 DESIGN REQUIREMENTS

A. Pumps shall be designed using hydraulic criteria based upon actual model developmental test data. Manufacturer shall certify that pumps have been hydraulically tested at the factory.

B. Head-capacity curves shall slope up to maximum head at shut-off. Select pumps near the midrange of the curve, so that the design capacity falls to the left of the best efficiency point, to allow a cushion for the usual drift to the right in operation, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).

C. Pumps shall be selected at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3% of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency.

D. Pumps of the same duty condition, classification, and accessories, or with specified accessory deviation, shall be of one manufacturing source.

E. Pumps from more than one manufacturing source shall be provided only when a single manufacturing source is unable to meet all Specification requirements.

15.04.1.3 SUBMITTALS

A. Shop Drawings: Installation drawings for pumps shall be submitted which shall include also layout, connections for pump. Include setting drawings with templates, directions for installation of foundation and anchor bolts as well as other anchorages.

B. Product Data: The following shall be submitted for pumps in accordance with paragraph entitled "General Requirements," of this Section.

   i. Equipment and performance data including certified performance curves and rated capacities, schedule of deviations, shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.

   b. Note: In the absence of deviations listed in the “schedule of Deviations” the pumps shall be deemed to be in full conformity with the specifications. The implied/indirect deviations shall not be binding on the project/Engineer.
C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 8

D. Warranty statement to cover one year after pump station handing-over.

E. Recommended spare parts list for 2 years operation.

15.04.1.4 GENERAL REQUIREMENTS

A. Equipment and performance data consisting of pump curves cubic meter (liter) per hour (second) versus total head in meters per rpm shall be provided for each type of pump.

15.04.1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models selected. Other manufacturers' pumps with equal performance characteristics may be considered.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in latest and relevant IEC standard, by a testing agency acceptable to the Engineer.

15.04.1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer’s Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.
15.04.2 - PRODUCTS

15.04.2.1 STANDARD COMMERCIAL PRODUCTS

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 10 years prior to bid opening. Products shall be supported by a local service organization.

15.04.2.2 GENERAL PUMP REQUIREMENTS

A. Pump set duty: Flow, T.M.H., are as shown on drawings and/or on the Bill of Quantities.
B. Pump efficiency at duty point: minimum 75%.

15.04.2.3 PUMP

A. Pump type: submersible multistage impellers designed for deep well installation.
B. Operating speed: 3000 RPM
C. Impellers type: Bronze impellers or stainless steel impellers, Impellers must be dynamically balanced with minimum vibration.
D. Pump to be suitable to operate water with 40 g/m3 solids content with hardness and granulometry similar to silt material.
E. Proposed pump must be manufactured in an ISO 9001 certified quality factory.

15.04.2.4 MOTOR

A. Motor type: Submersible fully enclosed with IP 68 protection standard and water cooled type. Motor to be suitable for deep well installation. Motor must be with water-tight insulated windings that ensure easy service, and improve cooling and extend its operating life.
B. Motor must be prefilled with food grade additives for freeze and rust protection, and must be suitable for potable water applications.
C. Motor connection to be according to NEMA standard. Starting: Direct, star-delta or auto-transformer.
D. Standard motor to be in compliance with NEMA standard Motor power rating to be not less than 20% of pump nominal power at duty points.
E. The rotating parts shall be statically and dynamically balanced.
F. Motor winding shall incorporate PT 100 probes as to safeguard against overheating. The motor windings shall be insulated, and motors shall operate continuously at rated voltage and frequency.
G. The motor shall be rated for a minimum power of 20% above pumpset nominal
power and shall be capable to drive the pump without over-loading through the full operating range of the pump from maximum capacity to shut off head.

H. The motor shall have a full-load power factor of not less than 75 percent. The locked rotor torque shall be not less than 100 percent of full-load torque. The breakdown torque shall be not less than 200 percent of full-load torque.

I. Maximum outside diameter of motor: 250 mm (10”)

15.04.2.5 DRAWINGS AND DATS

Complete fabrication, assembly and installation drawings, together with detailed Specifications and data covering materials used, parts, devices and other accessories forming a part of the equipment furnished, shall be submitted with the tender. Specifications for each unit shall include, but shall not be limited to, the following:

PUMPS:

A. Name of Manufacture; Type and Model; Rotating Speed;
B. Size of Discharge Outlet;
C. Net Weight of Pump;
D. Complete Performance Curves Showing Capacity, Versus Total Dynamic Head, NPSH
E. Required, Horsepower and Overall Efficiency; Data on Shop Painting;
F. Flexible Coupling Make and Type; Sectional Drawings and Dimensions;
G. Operation and Maintenance Manuals; Spare Parts Manual.

MOTORS

A. Name of Manufacturer; Type and Model;
B. Type of Bearings and Lubrication; Rated Size of Motor, hp;
C. Net Weight of Motor;
D. Temperature Rating;
E. Full Load rotating Speed;
F. Efficiency and Power Factor at Full Load, 3/4 Load and 1/2 Load; Locked Rotor Current
G. Rated Current and Voltage;
H. Sectional Drawings and Dimensions; Operation and Maintenance Manuals; Spare Parts Manual.

15.04.2.6 DEMONSTRATION
A. Engage a factory-authorized service representative to train the Owner’s maintenance personnel to operate, and maintain the pumps.
SECTION 15.05 PROCESS PIPING – CARBON STEEL

15.05.1 GENERAL

15.05.1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all non-buried steel pipe and appurtenances as shown on the Drawings, BOQ, and as specified herein.

15.05.1.02 RELATED WORK

A. Valves in Section 15.01.
B. Flowmeters in Section 15.02
C. Gauges in Section 15.03

15.05.1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data
   1. Piping layouts in full detail.
   2. Location of pipe hangers and supports.
   3. Location and type of backup block or device to prevent joint separation.
   4. Large scale details of wall penetrations and fabricated fittings.
   5. Schedules of all pipe, fittings, special castings, couplings, flanges, expansion joints and other appurtenances.
   6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, flanges and other accessories.
   7. Brochures and technical data on coatings and linings and proposed method for application and repair.

15.05.1.04 REFERENCE STANDARDS

A. ASTM International and equal European standard
   1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

B. European standards
C. DIN EN 1092-1 Steel Pipe Flanges

D. American National Standards Institute (ANSI)
   1. ANSI B16.5 - Pipe Flanges and Flanged Fittings

E. American Welding Society (AWS)

F. American Water Works Association (AWWA)

G. American Society of Mechanical Engineers (ASME)

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

15.05.1.05 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

D. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, and paint thinner and acid solder.

15.05.1.06 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading take care to prevent damage to pipes and coating.
   Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.
15.05.2 PRODUCTS

15.05.2.01 MATERIALS, GENERAL

A. General installation materials shall be as specified below.

1. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe.

2. Flanged Joints. Bolt and nuts, Type 304 stainless steel, bolt number and size same as flange standard; studs - same quality as machine bolts; 1/16-in thick rubber gaskets with cloth insertions; rust-resistant coatings.

3. Temporary Plugs shall be standard plugs or caps which are suitable for permanent service.

15.05.2.02 CARBON STEEL

PROCESS PIPING A. Pipe

furnished to this standard

B. Carbon steel seamless pipe grade B, schedule 40 or 60 shall be manufactured in accordance with the requirements of the latest edition of API Spec. 5L, as supplemented by these specification

15.05.2.03 PIPE CONNECTIONS

A. Threaded connections ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1

B. Flanged connections shall be EN 1092 with pressure rating that exceeds the working pressure and as shown on the drawings and BOQ and as approved by submittal.

C. Flange gasket material shall be suitable of the application. The material shall be certified by the manufacture for a pressure rating equal to or greater than the flange PN, and approved for use on potable water supply.

15.05.3 EXECUTION

15.05.3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to
avoid passing through ductwork or directly under electric light outlets and/or interference with other lines. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, and undersize or out of round. Ends shall be carefully reamed and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. Do not use bushings except where specifically approved by the Engineer.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

5. Mitering of pipe to form elbow is not permitted.

6. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the pipe test.

15.05.3.02 STEEL PIPE INSTALLATION

A. Steel pipe shall be installed true to alignment, and rigidly supported anchors shall be provided where required and as shown on the Drawings.

B. All threads shall be clean, machine cut and all pipe shall be reamed before erection. Each length of pipe as erected shall be up-ended and rapped to dislodge dirt and scale.

C. Screwed joints shall be made up with good quality thread compound and applied to the male thread only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. All joints shall be air tight.

D. All piping shall have a sufficient number of unions to allow convenient removal of piping. Unions shall be compatible with pipe.

E. When cutting of pipe is required, the cutting shall be done by machine in a neat workmanlike manner without damage to the pipe. Cut ends shall be smooth and at right angle to the axis of the pipe.

15.05.3.03 WELDING

A. Welding in accordance with ANSI B31 and AWS B3.0.
B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

C. All field welding shall be in accordance with the AWS. The strength of the field weld shall develop the strength of the pipe.

15.05.3.04 FLANGED JOINTS

A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same EN standard as flanges.

Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

15.05.3.05 DISINFECTION

A. All potable water piping shall be thoroughly cleaned, degreased, flushed, and disinfected before entering into service.

B. The disinfection solution shall be not less than 50 parts per million of available chlorine. The disinfecting solution shall be allowed to remain in contact with the interior pipe surfaces for a period of 3 hours after which time and then flushed with clean water. Disinfected sections shall be put into service and tested immediately following disinfection.

15.05.3.06 IN-SERVICE PIPE TESTING

A. Short pipe sections installed or worked on shall be in-service tested, including pump suction and discharge pipe and fittings. In-service pipe testing is only for exposed piping and fittings.

1. Test pressure is the maximum working pressure of the system for a minimum test period duration of 24 hours.

2. Any visible leakage during the test period is considered a failure. Any section that fails the test shall be removed from service, repaired, disinfected, returned to service, and re-tested for the full test period duration.

3. All pipe testing shall be scheduled with the Engineer, and the Engineer must be present for at the start of the test. Upon completion of the test period the Engineer will verify completion of the test.
DIVISION 16

ELECTRICAL WORKS

ELECTRICAL GENERAL PROVISION (16000)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

B. Bill of Quantity (BOQ)

1.2 SCOPE OF WORK

1.2.1. The scope of electrical work for the station will include but is not necessarily limited to: A. Power Supply and Distribution consisting of:

   ▪ Main distribution boards,
   ▪ Motor Control Centers,
   ▪ Cables, wires and related accessories,
   ▪ Cable trays, Conduits, wireways, supporting systems and related accessories,
   ▪ Earth and Lightning systems.

1.3 GENERAL REQUIREMENTS

1.3.1. INSTALLATIONS GENERALLY:

A. Carry out electrical work in accordance with the Drawings, Specification and Regulations, ensuring compliance with design and performance requirements, to provide safe and protected systems with equipment readily accessible for operation, maintenance and repair.

B. Installations are to be complete, ready for operation and fully integrated and coordinated with all other work.

C. Installations are to be carried out by qualified personnel.

D. Provide accessories necessary to complete the installations, of the types specified or recommended for the purpose by the manufacturer of the equipment or accessories.

1.3.2 EQUIPMENT SPACES AND ROOMS:

check that dimensions, structure, ventilating and cooling arrangements and other provisions in equipment spaces and rooms are suitable for installation, operation and...
maintenance of proposed equipment. Note any discrepancies on the shop and construction drawings. The Contractor is responsible of planning the erection of the electrical equipment such that it is not interfering with any other trade in the station.

1.3.3. POWER SUPPLY: liaise with the Local Power Authority to confirm:
1. Characteristics of supply and system earthing
2. Location of incoming supply shown on the Drawings
3. Space requirements and associated builder's work for the Authority's installations.
4. Make necessary arrangements at the earliest opportunity to ensure connection as and when required, and inform the Engineer in the event of any foreseen delay.

1.3.4. Systems used before substantial completion for the benefit of the Contractor are to have all consumable elements, such as lamps etc. and defective equipment replaced by new, within 7 days prior to the date of substantial completion.

1.4 DESIGN CONDITIONS

A. Nominal characteristics of power supply and distribution are as follows:
1. Low voltage : 400 V, 3 phase, 4 wire, solidly earthed neutral
2. Frequency : 50 Hz,
3. Earthing System : TN-S (solidly grounded neutral with separate grounding conductor)

B. DISTRIBUTION SYSTEMS are to be supplied or derived from the voltage system previously described, as shown on the Drawings, or as otherwise specified.

C. EQUIPMENT is to be designed for the system voltage and frequency previously described, unless otherwise specified. Special provisions are to be made for equipment sensitive to power supply frequency and voltage variations and for equipment operated at other voltages/frequencies or by direct current sources.

D. CLIMATIC CONDITIONS: equipment, including transformers, switchgear, cables, relays, lighting fixtures, motors etc., is to be designed and derated for continuous and trouble free service under the following climatic conditions:
1. Altitude : at sea level
2. Maximum ambient temperature: 35 deg. C (in the shade)
3. Minimum ambient temperature: 4 deg. C
4. Maximum relative humidity: 90%
5. Atmospheric conditions: 1 bar

E. Where design and operating conditions, different from the above are required for particular equipment, they are described in the specification of the equipment concerned.

F. REGULATIONS: carry out electrical work in accordance with the current issue of the local codes of practice, local power authority regulations and IEC Regulations for Electrical Installations, where not in contradiction with the local codes of practice and regulations, herein referred to collectively as 'the Regulations'.
G. CONFLICT should an instance occur in this specification or on the drawings in which material or construction methods called for are less than minimum requirement of the Regulations, the Engineer shall be immediately informed in writing. Consequent to Engineers approval, supply the materials and perform the work as through called for to minimum code standards.

H. STANDARDS: unless otherwise specified, equipment and materials are to be manufactured and installed in compliance with the relevant recommendations of the following:

1. IEC: The International Electro-technical Commission
2. ISO: The International Standardization Organization
3. EN : European Norm
4. NF-USE : The French Regulation
5. BS : The British regulation
6. CCITT : The International Telephone and Telegraph Consultative Committee
7. CCIR : The International Radio Consultative Committee
8. CISPR : The International Special Committee on Radio Interference
10. IEEE : Institute of Electrical and Electronics Engineers, Inc.

or other equal and approved standards, herein referred to as 'the Standards'. Local standards, where enforced and relevant, are to have precedence over the Standards.

1.5 THE DRAWINGS

A. EQUIPMENT LOCATIONS shown on the Drawings indicate the approximate locations and general layout of equipment. Exact and final locations and layouts together with dimensions, weights, mounting methods and accessories, where relevant are to be shown on the shop and construction drawings. All protecting device shall show: the short circuit current value for single and three phase current, the voltage drop, the indirect protection function in case of a fault with respect the earthing system.

B. WIRING LAYOUTS shown on the Drawings are to be used as a guide only to defining basic positions, circuiting, loading and switching arrangements. Actual layouts and details of routing of circuits are to be shown on the shop and construction drawings.

C. SYMBOLS: in order to provide sufficient detail and a minimum degree of clarity on the drawings, the symbols used for the various electrical devices, particularly wall mounted devices, take up more space on the drawings than the device does on the wall. Because of drafting limitations these locations must be considered as being symbolic rather than exact physical locations of the devices.

D. The devices shall be installed with prime regard for convenience of operation and the best usage of the wall space for this and other purposes rather than string the devices out along the wall so as to coincide with the scaled locations of the symbols. In locating the outlets, follow the criteria provided on detail drawings where provided, and co-ordinate with furniture. Submittal of detail drawings is required for this purpose before execution. Do not scale from design drawings.
1.6 EQUIPMENT AND MATERIALS

A. AVAILABILITY: confirm availability of equipment and materials proposed for use in the work prior to submission for approval. If, after approval, equipment or materials cease to be available, submit alternative items of equal quality and type for approval.

B. ACCEPTANCE BY AUTHORITY: confirm that proposed equipment and material characteristics where required are compatible with the requirements of the Local Power Authority or other authorities having jurisdiction and are acceptable to them. Inform the Engineer of any modifications necessary to comply with the Local Power Authority's requirements.

C. MANUFACTURERS' STANDARDS: equipment is to be the latest standard product of the manufacturer. Component parts are to be the product of a single manufacturer, unless otherwise approved and provided that components made by other manufacturers are of a standard design and are interchangeable.

D. APPROVED MANUFACTURERS (Only western European, Japanese and North American are approved): listing of approved manufacturers in the Specification does not necessarily constitute approval of their standard products as equal to those specified. As certain that listed manufacturers are able to supply equipment and material in conformity with the Specification.

E. FACTORY ASSEMBLY: equipment generally is to be supplied in complete factory assembled units ready for installation on site. Dis-assembly necessary for transportation or other purposes is to be arranged to limit site work to simple re-assembly and inter-wiring of control and power cabling.

F. STORAGE OF MATERIALS: equipment and materials are to be stored in an approved location, under cover, free from humidity, dust, debris and rodents. Equipment sensitive to heat and humidity is to be kept in climatically conditioned areas until installed and handed over.

G. DEFECTIVE EQUIPMENT: the Employer reserves the right to operate operable defective equipment during the Defects Liability Period until it can be removed from service for repair or replacement.

H. WARRANTY: where required by the Specification, provide a warranty, signed by the manufacturer (including his agreement to replace promptly, defective equipment or parts thereof, as instructed by the Engineer) covering materials and workmanship for the period stated in the Specification, starting at substantial completion. The Contractor is to assign the benefits of such warranty to the Employer.

I. SPARE PARTS: not later than the date of substantial completion, provide spare parts required by the Specification, together with suitable means of identifying, storing and securing same.

J. TOOLS AND INSTRUMENTS: not later than the date of substantial completion, provide sets of tools and instruments required by the Specification, together with suitable means of identifying, storing and securing same.

K. LABEL AND IDENTIFY all equipment, instruments, control and electrical devices etc. to indicate duty, service or function, to the satisfaction of the Engineer. Labels are to be laminated plastic or anodised aluminium discs with black surface and white
core with incised lettering in English or Arabic to the satisfaction of the Engineer. Alternative methods of labelling may be submitted for approval. Fix labels with non-corrodible screws to equipment, or to adjacent permanent surfaces or as approved by the Engineer.

L. EQUIPMENT NAMEPLATES are to be non-corroding, robust metal, inscribed in English, and firmly fixed to equipment at factory. Nameplates are to indicate name and address of manufacturer, model, serial number, basic characteristics and ratings of equipment and are to include elementary diagrams etc., all in accordance with the Standards.

1.7 SUBMITTALS

A. Approval of submittal: Approval of a submittal does not relieve the contractor from the specifications and contractual obligations. Each submittal should show a schedule of compliance sheet, addressing each point mentioned in the specifications and/or in the BOQ, these points should be numbered and each number should be highlighted with the relative number on the original certified catalogue. Any deviation or omission from the specifications shall be clearly stated in a compliance sheet.

B. Coordination: Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay, and allow for 2 weeks time for review.

C. Submittal Preparation: Place a permanent label or title block on each submittal (including shop drawing) for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Include the following information on the label for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Reference number for the submittal with revision number if the same submittal has been submitted before.
   d. Name and address of the Architect.
   e. Name and address of the Contractor.
   f. Name and address of the subcontractor.
   g. Name and address of the supplier.
   h. Name of the manufacturer.
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.

D. Product Data: Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
   a. Manufacturer's printed recommendations.
   b. Type of usage and location.
   c. Reference number in contract documents (Specifications, dawings)
d. Compliance with recognized testing agency standards.
e. Application of testing agency labels and seals.
f. Notation of dimensions verified by field measurement.
g. Notation of coordination requirements.

2. Provide complete original catalogues of product when relevant or when requested.

3. Include Installation and Operation manual with each applicable submittal.

E. SAMPLES: Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

F. Operation and Maintenance Manuals: Include Operation and Maintenance manual for each equipment. Identify each equipment and include the local supplier’s name and full address, the manufacturer’s manual, in addition to recommended spare parts.

1.8 SHOP DRAWINGS

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project will be rejected.

B. Submit Builder’s Work drawings showing Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

C. Shop drawings shall be prepared electronically editable on Autocad similar to the edition of the original drawing and not less than AutoCad 2007. Layers, sizes and all other drawing requirements shall be followed as per instructions of the Architect/Engineer. These shall be made and presented to suit for the elaboration of composite drawings.

D. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include information as required by individual sections, in addition to the following information:
   a. Dimensions, distances, invert levels, operating clearances, location of access required.
   b. Identification of products and materials included by sheet and detail number.
   c. Accessories, connections to other services, electrical connections, etc.
   d. Notation of coordination requirements.
   e. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit general layouts on 1/50 scale, and details on 1/20.
   f. Submittal: Submit 4 blue- or black-line prints for the Architect/Engineer review. The Architect/Engineer will return one print.
   g. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
h. Submit electronic copy after approval of drawing.

E. Shop drawings are to be checked thoroughly and coordinated to avoid interference with structural elements, finishing requirements and the work of other trades.

F. Shop drawings and redesign shall be prepared electronically editable on Autocad similar to the edition of the original drawing and not less than R20. Layers, sizes and all other drawing requirements shall be followed as per instructions of the Architect/Engineer. These shall be made and presented to suit for the elaboration of composite drawings. Shop drawings and redesign should be done even if changes on Architectural drawings are important and even if redesign of some parts of the areas are requested.

1.9 COORDINATED COMPOSITE DRAWINGS

A. Participate in site meetings to coordinate shop drawings between all construction trades.

B. Submit coordinated composite drawings showing interference of all trades on one sheet, including composite sections and elevations.

C. Submit Composite drawings showing reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, drainage pipes, water supply and other ceiling-mounted items

1.10 AS BUILT DRAWINGS

A. As-Built Drawings: On completion of the works of each area, system or floor, submit four sets of prints of each applicable drawing for the mechanical and plumbing installation, showing the exact position of all apparatus, plant, duct and pipework runs, valve positions, grille and diffuser locations, etc. with all appropriate labeling to the Architect/Engineer's requirements. All as-built drawings must conform in all respects to the pattern of the Contract Drawings, and to the approval of the Architect/Engineer.

B. As-Built drawings shall be submitted directly after approval of the installation, and prior to testing and commissioning. A draft copy shall be submitted before closing shafts, ceiling or any obstructing element.

C. The words "As Built Drawing" shall be clearly indicated on all drawings adjacent to the title cover. As-built drawings will be subject to Architect/Engineer approval. Contractor to submit hard copies and also soft copies of all as built drawings on DVDs to the Architect/Engineer after the approval of the as built drawings.

1.11 OPERATION AND MAINTENANCE MANUAL

A. Before Final Handing over submit a draft copy of a complete Operation and Maintenance manual that include:
   1. A documentation Directory
   2. Emergency information
   3. Operating manual
5. Test reports
6. As built drawings

B. Documentation directory: Submit an index of all O&M documents in a well-organized manner identified to ease the access of information and reflecting the hierarchy of the project: System, sub-system, Equipment, component.

C. Emergency information: a document that should be readily available for emergency situation that include, for each system, information needed for type of emergency, with the notification activity and the responsibility of the personnel.

D. Operating manual: A document that contains all information needed for day-to-day operation and management of the systems.

E. Maintenance Manual: In addition to manufacturer supplied maintenance manuals, provide for each equipment:
   1. Description of equipment
   2. Recommended maintenance procedures and their frequency.
   3. Recommended list of spare parts with their number and reference.
   4. Original purchase order number, supplier’s name, address and phone number.
   5. Intervention needed in case of failure and Installation information.

F. Testing reports: Include test results from the testing and commissioning process.

G. Construction documents include AS-built drawings, specifications, approved submittals, schedule of equipment, warranty certificates, …

1.12 GENERAL SUBMISSIONS

A. GENERALLY: submit for approval, manufacturers' technical literature, shop and construction drawings and other information required by the Specification, before ordering equipment or materials and before executing any related work on site.

B. TECHNICAL LITERATURE is to include detailed manufacturers' specifications and original catalogues or catalogue cuts, characteristics, model number, application and operating criteria of all equipment and materials, together with other information necessary to satisfy the Engineer that proposed equipment and systems are suitable and adequate.

C. LIST OF PROPOSED MANUFACTURERS of all equipment and materials, including all items for which choice of manufacturer is at the discretion of the Contractor, is to be submitted for approval.

D. TEST CERTIFICATES AND REPORTS: where required by the Specification, submit manufacturer's type and routine test certificates and reports for equipment and devices. Complete test results are to be submitted in clearly identified and organised booklets, indicating item of equipment, make, model, type, date of tests, type of tests, descriptions and procedures.

E. SPARE PARTS SCHEDULES: submit with the Tender itemized schedules of spare parts to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.
F. TOOLS AND INSTRUMENTS SCHEDULES: submit with the Tender itemized schedules of tools and instruments to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.

G. LABELLING SCHEDULE: submit for approval, prior to installation, a schedule of all equipment and devices to be labeled and the suggested details, lettering, position and fixing methods of each label indicating its application.

H. SAMPLES: submit samples of all equipment and materials for approval. Major items of equipment for which samples cannot be submitted are to be demonstrated in existing installations or by manufacturer's information, test certificates and reports.

PART 2 - SPECIAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

2.1 REQUIREMENTS

A. CONSTRUCTION: electronic components of communication systems, security systems and special systems and electronic components forming part of the power generation and distribution system are to be solid-state integrated construction, unless otherwise approved.

B. TEMPERATURE LIMITS: manufacturer is to indicate maximum and minimum ambient temperatures acceptable for the equipment to operate continuously and normally and beyond which electronic components may suffer permanent damage.

C. ALTERNATIVE ELECTRONIC EQUIPMENT may be submitted for approval, provided such equipment meets or exceeds the functional capabilities and/or performance parameters of the equipment specified. Proposals for alternative equipment will be considered only if accompanied by the following information:
   1. List of operational characteristics and performance parameters.
   2. List of differences in operation and performance between proposed and specified equipment.
   3. List of changes required and resulting implications.
   4. Drawings indicating changes required to system wiring.
   5. Statement of advantages of proposed equipment over that specified.

D. PROTECTION: solid state equipment under normal conditions of operation is to withstand any surges which might be produced by sudden mains or standby power switching operations. Protective devices are to be provided to protect against surges, failure of output stages due to open circuit, short-circuit or impedance mis-match. In the absence of IEC standards comply with IEEE standard 472 (ANSI/IEEE C37.90 "Guide for Surge Withstand Capability Tests". System/equipment which may be adversely affected by short duration power blackouts shall be capable of riding through such a disturbance by having an internal battery back-up to the memory / microprocessor, etc.

E. ELECTROMAGNETIC RELAYS and control/small power transformers are to be designed to withstand the 500 V a.c. test voltage between winding and winding or winding and core.

F. DUST COVERS, easily removable for inspection and servicing, are to be provided for
all relays and sensitive elements.

G. OUTDOOR EQUIPMENT, electronic or other, is to be designed for maximum ambient temperature or direct sun and is to be protected/enclosed, as applicable, against dust and weather conditions.

H. EXTERNAL INTERFERENCE: carry out field investigations and tests to determine possible interference from outside sources. Design electronic equipment to ensure trouble-free operation.

I. SEGREGATION OF WIRING: design wiring so that low current circuits are segregated from power wiring, using different conduits and wireways for the purpose. Composite wiring is acceptable for the same system in accordance with the relevant codes. Cable insulation is to be same grade for all conductors in a common enclosure.

J. POWER SUPPLY UNITS for low current systems which are fed from the LV supply are to be independently fused on the live conductor and are to have front panel mains indicator light, on/off switch and standard cartridge type fuse holder. Blown fuse indicator lamp is to be provided when fuse does not have an indicator.

PART 3 - TESTS ON SITE, RECORDS, TRAINING AND MAINTENANCE

3.1 TESTS ON SITE

A. GENERALLY: carry out inspection and acceptance tests on site on each complete system, before final placement into service, in accordance with the Regulations and Standards, as described in the Specification and required by the Engineer.

B. TEST SCHEDULES AND PROCEDURES are to be submitted for approval and are to include details of testing equipment to be provided.

C. WITNESSING: inspection and acceptance tests are to be carried out in the presence of the Engineer.

D. VISUAL INSPECTION: visually check proper installation, connections and nameplate data before testing.

E. INSULATION RESISTANCE: test the feeders, lighting and power circuits, motors and other power equipment of low voltage installations with a megger of not less than 500 V d.c. for installations rated up to 500 V (r.m.s. value of a.c. supply) and 1000 V d.c. for installations rated above 500 V up to 1000 V, and as required by the particular Section of the Specification.

F. INSULATION RESISTANCE: unless otherwise specified or approved, test the circuit insulation resistance related to communications and security systems with a megger of not less than 500 V operating voltage, with equipment disconnected.

G. CONTINUITY: test all feeders and circuits for continuity.
H. OPERATIONAL TESTS: carry out operational tests on all equipment and complete systems to verify proper performance in compliance with the Specification.

I. LOAD BALANCE: upon completion and immediately prior to final inspection and take-over, check load balance on all feeders and at distribution centers, panels, etc. Conduct tests by turning on all possible loads in the station and checking the load current balance. If load unbalance exceeds 15%, rearrange and reconnect circuits to balance the load after Engineer's approval.

J. VOLTAGE CHECKS: perform voltage checks throughout the station and if directed by the Engineer, adjust the transformer tap settings where a transformer is provided on the supply end, or report to power authority for adjustment necessary.

K. CURRENT CHECKS: In cooperation with the mechanical sub-contractor, take clip-on ammeter readings on all phases of all mechanical equipment motors with motors operating under full load conditions. Test readings shall be submitted to the Consultant.

3.2 RECORDS

A. GENERALLY: not later than the date of substantial completion, provide the Engineer with four copies of all approved as-installed drawings, test records, manufacturers' guarantees and warranties, operating and maintenance manuals and other records required by the Specification.

B. PRESENTATION OF RECORDS is to be in A4 size plastic covered, loose-leaf ring binders or other approved binders with hard covers, each indexed, divided and appropriately cover titled. Drawings larger than A4 size are to be folded in the binders so that they may be unfolded without being detached.

C. AS-INSTALLED DRAWINGS are to contain the complete assembled information included on the construction drawings, prepared in the same manner, and up-dated to indicate the systems, labelling, referencing, mounting methods, routing etc. as installed.

D. TESTING COMMISSIONING: Include test results from the testing and commissioning process. Tests for all and each of the equipment and accessories should be done in presence of the manufacturer representative, the commissioning to be done by a specialized team with the know how of similar jobs.

E. TEST RECORDS are to include test certificates of type tests, site tests, commissioning and performance tests and all other tests on equipment and installations described in the Specification and required by the Engineer. Information is to include test procedures and results, conditions under which tests were carried out including set points, temperatures and the like, dates, location and attendance by authorised representatives etc.

F. OPERATING AND MAINTENANCE MANUALS are to contain the following:
   1. Technical description of each system and item of equipment installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.
   2. Diagrammatic drawings of each system indicating principle components and items of equipment.
3. Schedules (system by system) of equipment installed giving manufacturer, catalogue list numbers, model, rating, capacity and operating characteristics; each item is to have a unique code and number, cross-referenced to the diagrammatic drawings and layout drawings.
4. Name, address, telephone, telex and fax numbers of the manufacturer of every item of equipment.
5. Name, address, telephone and e-mail of equipment agents/representatives for emergency services and procedures.
6. Manufacturer's service manual for each major item of equipment, assembled specifically for the project, including detailed drawings, illustrations, circuit details, operating and maintenance instructions, modes of operation, control provisions, sequences and interlocks and preventative maintenance programme.
7. Procedures for fault finding, where applicable.
8. Manufacturers' lists of recommended spare parts for items subject to wear and deterioration, giving expected running period and indicating specifically those items which may involve extended deliveries.

3.3 TRAINING

A. OPERATION AND MAINTENANCE TRAINING: before the date of substantial completion, explain and demonstrate to the Employer's maintenance staff the purpose, function and operation of the installations including all items and procedures listed in the operating and maintenance manuals.

CONDUITS, WIREWAYS AND RELATED ACCESSORIES (16110)

PART 1 - GENERAL

1.1 ELECTRICAL WORK GENERALLY: is to be in accordance with the requirements of Section 16010 of the Specification.

1.2 RELATED DOCUMENTS: Bill of Quantity (BOQ).

1.3 DESCRIPTION OF WORK: raceways including conduits, wireways and related installations and accessories necessary to support and protect cables, feeders, branch circuit wiring and wiring of low current systems, communications and signal cables.

1.4 REGULATIONS AND STANDARDS: conduits, wireways, cables trays and fittings are to be designed, constructed and installed to give safe installation and reliable mechanical protection for wires and cables in accordance with the Regulations. Standards of products are to be as specified.

1.5 TECHNICAL DATA: submit data for approval including, but not limited to,
the following:

A. Manufacturer's catalogues with specifications of raceways including conduits, trunking etc. and related accessories.

B. Samples of each type of raceway and accessory.

1.6  **SHOP AND CONSTRUCTION DRAWINGS:** submit drawings for approval including, but not limited to, the followings:

A. Exact routing of conduits, trunking etc. With indication of boxes, accessories and expansion joints, size of conduits and boxes

B. Typical assembly details of installation of trunking, trays

c. Construction details of pull boxes.

D. Typical installation details including connection of conduits to metal enclosure. Connections of flexible conduits, vapour- tight installations, liquid tight flexible metallic outdoors etc. and earthing connections.

1.7  **APPROVED MANUFACTURERS:** obtain conduit, wireways and related accessories from one of the following or other equal and approved: UNIVOLT (Austria), DIELECTRIX (England), DECODUCT (UAE).

2.1  **CONDUITS AND ACCESSORIES**

A.  **RIGID & FLEXIBLE METAL CONDUIT**

1.  **FLEXIBLE METAL CONDUIT:** steel, cold rolled and annealed, non-threaded type, formed from continuous length of helically wound and interlocked strip steel, with fused zinc coating on inside and outside.

2.  **RIGID METAL CONDUIT:** Black enameled or hot dipped galvanized, L= 3m, screwed on both ends to NF-C-68-100.

3.  **LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT:** is to have PVC jacket extruded over core.

4.  **FITTINGS GENERALLY:** thread less, hinged clamp type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated.

5.  **STRAIGHT CONNECTORS:** one piece body, female type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated.

6.  **ANGLE CONNECTORS:** of 45 or 90 degree and terminal connectors are to be as specified for straight connectors, except that body is to be two-piece with removable upper section.

B.  **RIGID MEDIUM GAUGE PVC CONDUIT**
1. MATERIAL: rigid un-plasticized, could form a bend with PVC accessories, polyvinyl chloride with high impact and high temperature resistance, non hygroscopic and non-porous, compressive strength $\geq 750$ N, to CEE 26, EN 50086, DIN 49026, NFC 68-107 or other equal and approved standards conforming to IEC 423.

2. ASSEMBLY: conduits, boxes and accessories are to be assembled by cementing, using manufacturer’s recommended products and appropriate connectors or spouts are available use smooth bore male PVC bushes and sockets.

C. FLEXIBLE MEDIUM GAUGE PVC CONDUIT

1. MATERIAL: heat resistant, non-hygroscopic PVC, high resistance to impact, ribbed on circumference for flexibility.

3.1 CONDUIT AND WIREWAYS GENERALLY

A. USE: unless otherwise specifically indicated all light and power circuits, communications, signal and low current systems wiring are to be drawn inside conduits or wireways up to the various electric power consuming equipment as shown on the Drawings. Separate conduit and wireways installations are to be used for LV cables/wires normal lighting and power circuits, emergency lighting and power circuits and communication, signal and other low current systems wiring.

B. BOXES: junction, pull and splice boxes of ample capacity (with 30% spare at least) are to be provided as indicated or required. Boxes are to remain permanently accessible.

C. TOOLS AND ACCESSORIES: for forming and installing conduit and wireway systems are to be purpose made for the particular application and used in accordance with manufacturer’s instructions.

D. FIXING: conduits and wireway installations are to be concealed as much as possible.

E. SIZES: Unless otherwise specified conduits and wireways sizes, not shown on the Drawings, are to be selected in accordance with the tables on design drawings and in relation to the number and size of conductors. Minimum size of conduit for all applications is to be 20 mm diameter, unless otherwise shown on the Drawings.

F. MECHANICAL CONTINUITY: conduits and wireways are to be effectively joined together (special cement) and connected to electrical boxes, fittings and cabinets (threaded glands) to provide firm mechanical assembly. Earthing jumpers are to be installed on steel conduits where required to ensure effective electrical continuity irrespective of whether a protective earth conductor is required or not.

3.2 RACEWAY APPLICATIONS AND INSTALLATIONS GENERALLY

A. RIGID MEDIUM GAUGE PVC CONDUIT: is to be used generally in underground, in screed, in duct banks and surface installation for lighting, power and light current circuits.
B. FLEXIBLE MEDIUM GAUGE PVC CONDUIT: is to be used for lighting, power
and light current circuits in under tiles and walls installation and for connection to
fixtures installed in false ceiling, unless otherwise specified or mentioned on the
drawings.

C. FLEXIBLE STEEL CONDUIT: is to be used, in the technical rooms, for
connection vibrating and non-rigidly fixed equipment and lighting fixtures.

D. FLEXIBLE LIQUID-TIGHT STEEL CONDUIT: is to be used, in the pumps rooms,
for connection vibrating and non-rigidly fixed equipment and lighting fixtures.

E. RIGID STEEL CONDUIT: is to be used for exposed installations in technical areas
(except pumps rooms) and where requested by NFC 15-100.

F. RIGID STEEL PVC COATED CONDUIT: is to be used for exposed installations in
the pumps rooms and technical rooms with involve water handling.
G. EXPOSURE TO DAMAGE: conduit considered to be subject to undue risk of damage by shock or corrosion is to be brought to the attention of the Engineer.

H. CROSSINGS: conduits are not to cross pipe shafts, vents or openings.

I. CLEARANCES: install conduits at least 100 mm clear of and preferably above pipes of other non-electrical services.

J. SLEEVES: obtain approval for positioning sleeves where conduits pass through reinforced concrete. Additional openings may be allowed in finished slabs but are to be drilled and not broken. Fix sleeves rigidly to maintain position and alignment during construction work.

K. EXPANSION FITTINGS: provide in each conduit run over 30 mm in length and at crossing of expansion joint in structure.

L. WATERPROOF CONSTRUCTION: conduits are not to cross waterproof construction unless permitted by the Engineer. Specially designed and approved fittings are to be used.

M. MAKE GOOD all holes for conduits passing through walls, floors and ceilings with cement or similar material to full thickness.

N. BENDS: conduit runs between outlet, fitting and fitting or outlet and fitting are not to contain more than the equivalent of 2 quarter bends (180 degree total).

O. BENDING is to be made without damaging conduit or tubing and without reducing internal diameter. Methods of field bending are to be approved.

P. CUT ENDS are to be reamed to remove burrs and sharp edges.

Q. CONDUITS ENTERING COLD STORES are to be made vapor tight, so that vapor from outside cannot enter conduit.

R. DRAINING: arrange conduits so that condensed moisture can drain to screwed plug at lowest point.

S. BEFORE WIRING, conduits are to be swabbed through. Do not draw cables into any section of system until conduit and draw boxes are fixed in position.

T. CAPPING: conduits are to be properly capped until wiring conductors are drawn in.

U. CONDUIT AND FITTINGS INSTALLED OUTDOORS are to be watertight and highly resistant to corrosion. Use appropriate fittings, threaded and hubbed boxes, gaskets with screw on covers and the like.

V. TERMINATIONS: do not terminate or fasten rigid conduits to motor frame or base.

W. LENGTH AND RADIUS OF FLEXIBLE CONDUIT used for motors and vibrating equipment are to permit bending of feeder cables without damage to conductor or insulation.

X. FLEXIBLE CONDUIT FOR SLIDE RAIL MOUNTED MOTOR is to have sufficient slack to allow for movement of motor over entire slide rail length.
Y. PULLING WIRE: install 3 mm galvanized stranded steel wire or equivalent strength cord with wooden blocks fastened at ends, in empty service conduits (power, low current and signal).

Z. STANDARD ELBOWS are to be used for conduit sizes equal or greater than 20mm.

AA. TAGS: fit to conduits entering or leaving floors, walls or ceilings for identification of conduit and circuits. Tags are also to be placed at suitable intervals throughout the systems.

3.3 PVC CONDUITS

A. COUPLING OF CONDUIT and/ or termination into spouted fittings is to be made watertight and permanent using special cement.

B. TERMINATION: connect conduits terminating in switchgear, panel boards, trunking, adaptable boxes or non-spouted enclosures etc, with smooth bore male PVC bushes and sockets.

C. ENDS OF CONDUIT end conduit fittings are to be cleaned and jointed using PVC cement recommended by manufacturer.

D. SEMI-PERMANENT ADHESIVE: use in joints requiring expansion couplers.

3.4 EMBEDDED CONDUITS

A. CONDUITS IN CONCRETE SLABS: place conduits parallel to main reinforcing steel.

B. CONDUITS IN PARTITIONS OR SIDE WALLS: horizontal or cross runs are to be avoided.

C. PULL-BOXES are not to be used. If unavoidable, pull-boxes may be approved if located inconspicuously.

D. CONDUITS IN FLOOR OF BEDS ON GRADE: encase in concrete, minimum thickness 50 mm or to thickness allowed by architectural detail.

E. PVC CONDUITS IN REINFORCED CONCRETE STRUCTURES are generally to be installed after placing reinforcement and before concreting, if protected against damage, or are to be placed in grooves in formed in the concrete, if approved.
3.5 **EXPOSED CONDUITS**

A. CONDUITS ON WALLS: run neatly, horizontally or vertically.

B. SUPPORTS: use approved clamps, hangers or clips fastened by machine screws to expansion sleeves in inserts or to lead anchors.

C. SPACING OF CLAMPS OR CLIPS for supporting steel conduits is not to be greater than:

<table>
<thead>
<tr>
<th>Conduit Size (mm (inches))</th>
<th>Maximum Spacing of Supports (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (3/4)</td>
<td>1.5 m</td>
</tr>
<tr>
<td>25 (1)</td>
<td>1.5 m</td>
</tr>
<tr>
<td>32-38 (1-1/4-1-1/2) and above</td>
<td>2 m</td>
</tr>
</tbody>
</table>

D. SPACING OF CLAMPS OR CLIPS for supporting PVC conduits is not to be greater than:

<table>
<thead>
<tr>
<th>Conduit Size (mm (inches))</th>
<th>Maximum Spacing of Supports (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WIRES, CABLES SUPPORTING SYSTEMS AND RELATED ACCESSORIES (16120)

PART 1 - GENERAL

A. The section shall cover all wires and cables.

B. The Contractor shall supply and install all wires and cables necessary for the complete Electrical System, as indicated on the Drawings, as required, and as specified herein.

C. Related Documents: Bill of Quantity (BOQ).

PART 2 - WIRES & CABLES - LIGHTING & POWER

A. Single Core Wires (NYA) Cu/PVC to IEC 227
   1. This specification covers single core, PVC insulated wires, intended for internal wiring in dry locations, concealed in conduits.
   2. Conductors shall be of high conductivity annealed plain copper with concentric stranded conductors, to IEC 228.
   3. Minimum conductor size used shall not be less than 2.5 mm².
   4. All wires for lighting and power systems pulled inside conduits shall be single core, insulated with PVC compound, of grade not less than 300 / 500 volts, to IEC 227.

B. Multicore Cables (NYY) Cu/ PVC/ PVC to IEC 502
   1. NYY cables shall be used for supply of power to main distribution boards, secondary distribution boards, pumps, HVAC equipment and all external lighting and equipment.
   2. This specification covers single, two, three or four core cables, PVC insulated and PVC sheathed, rated at 600V/1000 V unarmored and armored type.
   3. Conductor shall be plain, annealed electrolytic copper, circular or sectoral stranded, conforming to the applicable requirements of IEC 228.
   4. The insulation shall be PVC based thermoplastic material conforming to the applicable requirements of IEC 502.
   5. The assembly shall consist of insulated conductors filled where necessary with non-hygroscopic material and covered with an additional layer of extruded thermoplastic material or non-hygroscopic binding tape.
   6. The sheath shall be PVC based thermoplastic material, conforming to the applicable requirements of IEC 502.
   7. Flexible cords for connection of fixtures to circuit-wiring shall have finely stranded copper Conductor with PVC insulation, type NYFAF, 500 V grade. Connection caps shall be "3M" instead of WAGO in this case only.
   8. Wires and cables shall be manufactured by BICC (UK), Pirelli (UK), Liban Cables (Lebanon) or approved equal.
PART 3 - FLEXIBLE CORDS

A. Cords used for water heater connections shall be of high conductivity tinned copper wires, (4 mm2 unless otherwise indicated) insulated with ethylene propylene rubber, three cores twisted together, filled and sheathed with chlorosulphonated polyethylene (EPR CSP), 300/500 V rated, and shall withstand an operating temperature of 85 °C.

B. Cords used for pendant lighting points and between 220 V / 12 V transformers to lighting fixtures, shall be circular three core (1.5 mm2) silicon rubber insulated, glass fiber braided 300/500 V rated and shall withstand an operating temperature of 170 °C.

C. Cords used for extract fans and fan coil units shall be of plain annealed copper conductor (2.5 mm2 unless otherwise indicated), PVC insulated, circular three cores twisted together, PVC overall sheeted 300 / 500 V rated and shall withstand an operating temperature of 70 °C.

D. Cords shall be manufactured by BICC (England), AEI (England) Pirelli (England), Liban Cables (Lebanon) or approved equal.

PART 4 - CONTROL CABLES

A. Control cables where used underground direct burial shall comprise stranded annealed copper conductor of minimum 2.5 mm2 cross-section insulated with high dielectric polyvinyl chloride, nylon sheathed with a tape binder applied over the assembly, overall PVC jacketed Control cables shall comply with IEC 502.

B. Number of conductors shall be equal to the maximum number of functions plus 20% spare.

C. Cable shall be 600/1000V insulated and sheathed grade.

D. Junction boxes shall include all necessary terminal connector boards with proper labels.

E. Contractor shall make sure that the cross-sectional area of the conductors is sufficient to cater for the voltage drop due to the long runs involved.

F. Control cables where used in ducts underground or in conduits above ground shall comprise stranded annealed copper conductor of minimum 1.5 mm2 cross-section for cables in ducts and 0.75 mm2 for cables in conduits insulated with high dielectric polyvinyl chloride, and PVC sheathed. Control cables shall comply with IEC 502.

PART 5 - INSTALLATION OF WIRES & CABLES

A. All wires shall be installed in accordance with the applicable provisions of the approved codes and as indicated on the Drawings.

B. The number of wires and sizes of conduits indicated on the Drawings are a guide only and are not necessarily the correct number and sizes necessary for actual equipment installed. The Contractor shall install as many wires and conduits as required and necessary for a complete electrical system, and shall provide adequately for the equipment actually to be installed.

C. Where more than one conductor is used per phase, each phase, neutral if any and ground wires shall be run in each metallic or non-metallic conduit.
D. Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes.

E. At every outlet and pull box, wires and cables passing through, shall be left slack by an amount equivalent to 20 cm of cable length to allow inspection and connection to be made therein.

F. No cable bend shall have a radius of less than eight times its diameter.

G. The Contractor shall not change any circuit number, especially from a phase to a different phase. If such a change is necessary due to modification on site, the Contractor shall bring this matter to the attention of the engineer.

H. All conductors to be contained within a single conduit shall be drawn in at the same time.

I. A wire pulling compound shall be applied to conductors being drawn through conduit. Pulling compound shall be soap tone or other approved material.

J. Only cables forming part of a lift installation if any may be run in a lift shaft.

K. Wires and cables for feeders, sub-feeders, control, and branch circuit wiring shall be color coded as follows:

<table>
<thead>
<tr>
<th>Color</th>
<th>Conductor Function</th>
<th>Alternative Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>L 1</td>
<td>Red</td>
</tr>
<tr>
<td>Black</td>
<td>L 2</td>
<td>Blue</td>
</tr>
<tr>
<td>Orange</td>
<td>L 3</td>
<td>Yellow</td>
</tr>
<tr>
<td>Light Blue</td>
<td>Neutral (N)</td>
<td>Black</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>Equipment grounding (PE)</td>
<td>Green/Yellow</td>
</tr>
</tbody>
</table>

L. Wire and cable sizes shall be as indicated on the Drawings; however in no case shall their size be smaller than required by the approved Code.

M. Unless otherwise indicated, no conductor for lighting and power wires shall be smaller than 2.5 mm².

N. All branch circuits for internal lighting and appliances shall be single conductor cables run inside conduits, unless otherwise indicated.

O. Feeder and sub-feeders shall be multi-conductor cables run exposed on cable trays or in underground ducts as shown on the Drawings.

P. Single cables unless otherwise specified and shown on drawings, could be fixed directly to walls or ceilings. Where 2 or more cables are run in parallel, they shall be fixed on hot dip galvanized steel perforated trays or other approved special cable supporting and protecting arrangement.

Q. Cables shall be fixed to supporting structures with approved hot dip galvanized cast steel clamps at distances not exceeding 20 diameters.

R. No joints or splices shall be accepted on main feeders.
PART 6 - IDENTIFICATION OF WIRES & CABLES

A. Identification scheme shall be as required by NF C 15-100 as a minimum.

B. Individual conductor or circuit identification shall be carried throughout, with circuit numbers or other identification clearly installed on terminal boards and printed on directory cards in distribution cabinets and panelboards. System shall be similar to Legrand CAB3 or approved equal.

C. In junction boxes, cabinets, and terminal boxes where the total number of control, indicating, and metering wires is three or fewer and no terminal board is provided, each wire including all power wires, shall be properly identified by means of a plastic, wire marker.

D. System shall be similar to Legrand Mémocab or approved equal.

E. Wires including motor leads and other power wires too large for connection to the terminal boards shall be identified by wire markers as specified above.

F. In manholes, hand-holes, pull boxes, junction boxes and at both terminals each cable shall be properly identified by a plastic tag located so as to be easily seen. System shall be similar to Legrand Duplix or approved equal. Wires and cables shall be identified by cable number indicated on the Drawings.

PART 7- CONNECTORS AND TERMINAL BLOCKS

A. For the wiring of circuits consisting of wire sizes 35 mm2 and smaller such as for lighting, branch circuits etc…, self insulated pressure cage clamp type connectors (similar to Wago) shall be utilized for all splices or joints. Where flexible cables (NYFAF) are used from ceiling outlet box to recessed lighting fixtures, 3M caps shall be utilized.

B. For the wiring of circuits consisting of wire sizes 50 mm2 and larger, connectors shall be of the bolted pressure type, with a pre-insulated sleeve. WAGO or Legrand Viking shall be used.

C. Connectors shall be manufactured from high conductivity electrolytic copper with soft tin-lead plating (Sn60Pb40).

D. Connector bodies shall be manufactured from Polyamid (Nylon 6.6).

PART 8 - CABLE TRAYS AND SUPPORTS

A. Cable trays shall be manufactured from mild steel of a minimum thickness of 2 mm. They shall be light or heavy duty type as required with return flanges, and hot-dip galvanized finish. Bends, corners, etc. shall be specially manufactured for the purpose.

B. All supports and accessories like hangers, channels, bolts, nuts, cable ties, conduit clamps, shall be furnished as to function, to the manufacturers standard. Metallic elements shall be hot dip galvanized.

C. The contractor shall provide technical catalogues and shop drawings to illustrate the sufficiency of the supports and tray sections thickness.
D. The installation shall have a design assuming double at the actual load in addition to the safety factor recommended by the tray manufacturer.

E. Cable trays, supports, and accessories shall be manufactured by BICC (England) or approved equal.

PART 9 - CABLE LADDERS

A. Cable ladders shall be manufactured from mild steel, with hot-dip galvanized finish.

B. All parts like flat elbows, offset reducers, cross pieces, tee pieces, drop outs, etc..., as well as accessories shall be furnished as to function, and to the manufacturers standards.

C. The contractor shall provide technical catalogues and shop drawings to illustrate the sufficiency of the supports and tray sections thickness.

D. Cable ladders, parts and accessories shall be manufactured by BICC (England), Planet-Walthom or approved equal.

PART 10 - CABLE GLANDS

A. Cable glands shall be provided at the termination of all cables at the enclosure of a distribution board or any other equipment.

B. Cable glands shall be indoor or outdoor type, ordinary or weatherproof according to the location of the termination, the installation standard and to the approval of the Engineer.
TRANSFER SWITCHES (16415)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, BOQ and general provisions and notes of the Contract, including Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switch.
   2. Bypass/isolation switch.

B. Related Sections include the following:
   1. Division 16 Section

1.3 SUBMITTALS

A. Technical Data: Include ratings and dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.

C. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

D. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for load ratings and short-circuit closing and withstand ratings applicable to units for Project.

E. Field Test Reports: Indicate and interpret test and inspection results for compliance with performance requirements.

F. Maintenance Data: For each type of product to include in maintenance manuals specified in Division 1. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE
A. Local Representative: Provide evidence that proposed equipment manufacturer has a locally established and authorized organization which can be called upon for professional advice and maintenance as may be required, and which can immediately supply spare parts to support day to day and emergency maintenance requirements. Failure to satisfy the Engineer may disqualify a manufacturer.

B. Source Limitations: Obtain automatic transfer switch, bypass/isolation switch and related control panels through one source from a single manufacturer.

C. Comply with IEC 947-6.

D. Comply with UL 1008, NFPA 70 and

110. E. Comply with NFPA 99.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, provide products of West Europe, USA or Japan origin, Certificate of Origin will be required

B. Locally assembled transfer switches meeting the Specification are acceptable.

2.1 MAINS FAILURE AUTOMATIC TRANSFER SWITCH (ATS)

A. Type: Conforming to IEC 947-6 or UL 1008 and to applicable standards. Wall or floor mounted, galvanized sheet steel cubicle of equal construction to control cubicle, comprising two main contractors, circuit breakers or double throw switches and controls necessary for automatic transfer of power supply from normal source to standby source, voltage sensing control relay and time delay relays to signal generator start and stop, auxiliary switches and indicating lights etc. as necessary for the required operation of the system.

B. Operation: When voltage and/or frequency of any phase drops below an adjustable setting (85-100%) of normal supply, for an adjustable period of 1 - 300 seconds, power failure relay is to actuate engine starting control, whilst normal mains contactor is to open. After an adjustable period of 0 - 10 seconds from sensing stabilized rated voltage and frequency of generator at the ATS, (Voltage pick-up adjustable from 85% to 100% nominal); frequency pick-up adjustable from 90% to 100% nominal, the emergency contactor is to close. Upon restoration of normal mains supply to above the preset limits, adjustable between 90% and 100% of rated voltage and/or frequency, for an adjustable preset period of 2 - 30 minutes, emergency contactor is to open and after a presettable pause 0.5 to 30 seconds minimum, normal mains contactor is to close; time delay is to be effective in both directions.

C. Engine Shutdown: Initiate after retransfer of the load to normal source. (Refer to generator set controls upon shut-down).

D. ATS for Large Motor Loads: Include factory-installed and factory-wired internal motor control under-voltage and timing relays. Relays control designated starters to de-energize motors prior to transfer and re-energize them selectively at adjustable time intervals after transfer. Control connection to motor starters is to be through wiring external to the ATS. Time
delay for motor starting is to be individually adjustable between 1 and 60 seconds. Relay contacts are to be rated for actual motor-control circuit inrush and seal currents, or for pilot duty as indicated.

E. ATS for Large Motor Loads: Where indicated, include factory-installed and factory-wired internal in-phase monitor relay. The relay controls transfer so it occurs when the 2 sources or source and load are synchronized in phase. The relay compares phase relationship and frequency difference between the normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if the transfer can be completed within 60 electrical degrees. In-phase transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage. Where an in-phase monitor is to be provided, this is to defeat the 'pause' in the transfer contactors and assume control of the switching operation.

F. Mechanical and Electrical Interlocks: Required to prevent contactors / circuit breakers from being closed simultaneously at any time. Transfer mechanism is to be powered from the source to which the load is being transferred.

G. Selector Switches are to be provided as follows:

1. Operating selector switch is to include the following:
   a. Normal: Generator set is set for automatic operation and the generator set starts if a power outage occurs, as described above.
   b. Test: Stimulates a power outage, starts and runs the generating set as Normal position.
   c. Stop: Shuts down the generating set and prevents it from starting. This is used when servicing the generator.

2. Another selector switch is to be provided for two positions, "With load" and "Without load" for testing or exercising:
   a. "With Load": the generating set is to carry the load during testing or exercising periods.
   b. "Without Load": generating set is to start but not assume the load.

H. Pilot Lights are to indicate which contactor is on.

I. Instruments are to include voltmeter and ammeter with selector switches.

J. Contactors are to comply with IEC 947, and UL Standard 1008, and be 3-phase, 4-pole, magnetic type, 600 V rating, capable of interrupting at least ten times rated current inductive or non-inductive loads under normal service conditions and are to have replaceable main arcing contacts and arc quenching devices. Contactors are to withstand, without welding or burning of contacts, an inrush current of 20 times normal rating for 4 seconds upon closing and are to be capable of closing on the heaviest short-circuit of the system and withstand the short circuit for period required by upstream short circuit protective device to operate. Three N.O. and three N.C. spare contacts are to be provided on each contactor.

K. Circuit Breakers used instead of contactors are to provide same functions as a minimum requirement and are to be electrically and manually operated non-automatic type.

L. Wiring: Moisture and heat resistant, silicon rubber insulated, stranded copper conductors, modularly and neatly arranged on master terminal blocks, with suitable
numbering strips and appropriate cartridge type fuses where required. Flexible wiring is to be used on all hinged/draw-out components.

M. Connections are to be made at a front terminal block with no live metal exposed. Power cables are to terminate on fixed insulated copper connectors suitably sized to receive specified cables. Cable glands and gland plates are to be provided.

N. Metal Cases of instruments, control switches, relays etc. are to be connected by flexible protective conductors, of not less than 2.5 mm² section, to nearest earthing bar or terminal.

O. Earthing: Earthing bar is to be provided for connection of protective earthing conductors, using set-screw or bolted anti-turn pressure terminations.

P. Ferrules: Wire ends are to be fitted with numbered ferrules of approved type at each termination.

2.2 ATS WITH MANUAL BYPASS SWITCHES

A. Provide Manual Bypass Switches to combine manual and automatic transfer operation with a drawout isolation system. Bypass switch is to consist of non-automatic Kirk-key interlocked switches or circuit breakers, fully rated, manually operated and rated for same loads as automatic transfer switch.

B. Bypass switch is to provide bypass to either normal or emergency source by use of a selector switch and a permanently mounted external lever, mechanically interlocked to prevent paralleling of sources.

C. An engine start switch is to be provided to allow generator set to be started when bypass is on emergency sources.

D. Bypass switch is to be of the make-before-break type. A dead source lockout is to prevent any possibility of bypassing the load to an unenergized source.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounted Switch: Level and anchor unit to floor.

B. Identify components according to Division 16 Section

3.2 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communications requirements of transfer switches as recommended by the manufacturer. Increase raceway sizes at no additional cost to Employer if necessary to accommodate required wiring.

3.3 CONNECTIONS
A. Ground equipment as indicated and as required by the Standards.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing in addition to tests recommended by the manufacturer:

1. Before energizing equipment, after transfer-switch products have been installed:
   b. Check for electrical continuity of circuits and for short circuits.
   c. Inspect for:
      1) Physical damage.
      2) Proper installation and connection.
      3) Integrity of barriers, covers, and safety features.
   d. Verify that manual transfer warnings are properly placed.
   e. Perform manual transfer operation.

2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Verify time-delay settings.
   c. Verify pickup and dropout voltages by data readout or inspection of control settings.
   d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.

B. Coordinate tests with tests of generator plant and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the system installation.
MOTOR CONTROL CENTERS (MCC) (16480)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, BOQ and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes motor-control centers for use on AC circuits rated 600 V and less as well as reduced-voltage magnetic controllers.

1.3 SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Shop Drawings: For each motor-control center specified in this Section. Include dimensioned plans, elevations, and component lists. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
   1. Schedule of features, characteristics, ratings, and factory settings of individual motor-control center units.
   2. Wiring Diagrams: Interconnecting-wiring diagrams pertinent to class and type specified for motor-control center. Schematic diagram of each type of controller unit indicated.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For products to include in the maintenance manuals.

E. Load-Current and Overload-Relay List: Compile after motors have been installed and arrange to demonstrate that selection of protections suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

C. Comply with IEC EN 60439 & IEC 364 for construction form as indicated on drawings comply with IEC 947-4-1, coordination type 2 for all motor drives.
D. **Product Selection for Restricted Space:** Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers and adjacent surfaces and items, and are based on types and models indicated. Other manufacturers’ motor-control centers with equal performance characteristics and complying with indicated maximum dimensions may be considered.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store so condensation will not occur on or in motor-control centers.

### 1.6 COORDINATION

A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load. The protections shall follow IEC 947-4-1, coordination type 2.

### PART 2 - PRODUCTS

#### 2.1 ENCLOSURES

A. Enclosures: Free standing cabinets as indicated. Unless otherwise indicated to meet environmental conditions at installed location. Motor control centers are to comply as a minimum with en 60439-1 factory-built type tested (TTA).

1. **Ingress Protection:** IP41 (provide anti-condensation heaters and submit thermal study to justify the panel’s cooling method).

2. **Compartments:** Modular; individual doors have concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units require disconnect means in off position before door can be opened or closed, except by consciously operating a permissive release device.

3. **Interchangeability:** Compartments are constructed to remove functional units without disturbing adjacent elements, disconnecting adjacent compartments, or disturbing the operation of other units in control center. Compartments are constructed to permit ready rearrangement of units, such as replacing 3 single units with a unit requiring 3 spaces, without cutting or welding.

4. **Wiring Spaces:** Each vertical section of structure with horizontal and vertical wiring has spaces for wiring to each unit compartment in each section, with supports holding wiring in place.

B. **Short-Circuit Current Rating for Each Section:** 30 % greater than indicated available fault current in symmetrical amperes at motor-control center location for 1 second minimum.
2.2 **BUSES**

A. Material: Tin Plated copper.

B. Ampacity Ratings: As indicated for horizontal and vertical main buses.

C. Neutral Buses: Full size, insulated and isolated from cabinet.

D. Equipment Ground Bus: Non-insulated, horizontal copper bus (50 by 6 mm), minimum as required by IEC standards.

E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or approved equivalent.

F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section for 1 second minimum.

2.3 **FUNCTIONAL FEATURES**

A. Description: Modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panel boards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.

B. Motor-Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
   1. Units have short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.

C. Overcurrent Protective Devices: Types of devices with features, ratings, and circuit assignments indicated.

D. Transient Voltage Surge Suppressors: Connected to motor-control center bus.

E. Spaces and Blank Units: Compartments fully bused and equipped, ready for insertion of units. F. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."

2.4 **MAGNETIC MOTOR CONTROLLERS**

A. Description: full voltage, non-reversing, across the line, unless otherwise indicated.

B. Control Circuit: 220 V; obtained from integral control isolation power transformer, unless otherwise indicated. Include a control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
C. Combination Controller: Factory-assembled combination controller and disconnect switch with overcurrent protection.
   1. Molded case non-fusible Disconnect: heavy-duty, non-fusible switch.
   2. Molded case circuit-Breaker Disconnect: motor-circuit protector (magnetic trip only)
      with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.

D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for duty cycle.

E. Star-Delta Controller: closed transition with adjustable time delay and overload protection.

F. Part-Winding Controller: closed transition with separate overload relays for starting and running sequences.

G. Contactor: To IEC standards 947-4-1, AC-3 or AC-4 rated as required by the application, in coordination type 2 with motor circuit breaker, thermal relay and motor nameplate data.

H. Solid-State, Reduced-Voltage Controller: Suitable for use with polyphase, medium induction motors.

   It shall comply with IEC 801-2, level 3 and IEC 801-4 level 4 for immunity to interference and directive 89/336/EEC for EMC requirements and IEC 664 for clearances and creepage distances.
   1. Adjustable acceleration rate control uses voltage or current ramp, and adjustable starting torque control has up to 500 percent current limitation for 20 seconds.
   2. Surge suppressor in solid-state power circuits provides 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
   3. LED indicators show motor and control status, including the following conditions:
      a. Control power available.
      b. Controller on.
      c. Overload trip.
      d. Loss of phase.
      e. Shorted silicon-controlled rectifier.
   4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.
   5. Motor running contactor operates automatically when full voltage is applied to motor.

2.5 SOFT STARTER MOTOR SET

A. Description: Soft starter drive controller, providing a soft starting and stopping of asynchronous squirrel cage motors.
The soft starter microprocessor shall control the torque during starting and stopping without any need for a tachogenerator. It shall comply with IEC 801-2, level 3 and IEC 801-4 level 4 for immunity to interference and directive 89/336/EEC for EMC requirements and IEC 664 for clearances and creepage distances.

B. Rating: to be at least as mentioned on the drawings.

C. Isolation transformer: Match transformer voltage ratings and capacity to system and motor voltages and controller, motor, drive, and load characteristics.

D. Standards:
4. Category of use: conforming to IEC 947-4-1 coordination type 2.

E. Electrical characteristics
1. Current adjustment: motor nominal current adjustable from 0.5 to 1.3 times the product rating.
2. Maximum starting current adjustable from 2 to 7 times the motor nominal current, and limited to 5 times the starter current limit.
3. Stopping: adjustable by programming from 0.5 to 60s.
4. Output relays: for end of start signaling.
5. Safety output relay: including 2 separate contacts 1 “N/O” + 1 “N/C”. those contacts could be reassigned (for isolation on stopping,..)
6. Analog output, 2 logic outputs and 3 logic inputs.
7. 1 isolated output (+24V) available from the soft starters for control purposes.
8. Thermal protection: microprocessor based, which monitors continuously the temperature rise of the motor and of the starter unit. The protection device shall be adapted for different starting closes (10A, 20, 30) and it shall be fitted with a thermal memory. The protection devices shall prevent the motor from restarting after a thermal fault, if the motor temperature is still too high.
   a. Phase failure and imbalance, indicated by output relay.
   b. Protection against short circuits less than 13IcL.

F. Display parameters: all messages shall be displayed on a digital LCD screen. The soft starter shall be fitted with soft-touch membrane keypad switches, LED pilot lights and multi-fault memory.

G. Communication port for J bus communication protocol.

2.6 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed transition; adjustable time delay on transition.

B. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
   1. Configuration:
      a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
      b. Part-Winding Controller: Separate START and RUN contactors, field- selectable for one-half or two-thirds winding start mode, with either six- or nine- lead motors; with separate overload relays for starting and running sequences.
2.7 VARIABLE-SPEED DRIVES

A. Description: Variable speed drive controller, listed and labeled as a complete unit and arranged to provide soft starting of a recognized standard, induction motor by adjusting output voltage and frequency.

B. It shall comply with IEC 801-2, level 3 and IEC 801-4 level 4 for immunity to interference and directive 89/336/EEC for EMC requirements and IEC 664 for clearances and creepage distances.

C. Design and Rating: Match type pumps or fans; and type of connection used between motor and load such as direct or through a power-transmission connection.

D. Isolation Transformer: Match transformer voltage ratings and capacity to system and motor voltages; and controller, motor, drive, and load characteristics.

E. Output Rating: 3-phase, 0.5 to 320 Hz, with torque constant as speed changes. F.

Starting Torque: 100 percent of rated torque or as indicated.

G. Speed Regulation: Plus or minus one percent.

H. Ambient Temperature: 0 to 40 deg C.

I. Efficiency: 95 percent minimum at full load and 320 Hz.

J. Isolated control interface allows controller to follow 1 of the following over an 11:1 speed range:

1. Electrical Signal: 4 to 20 mA at 24 V.

K. Internal Adjustability: Include the following internal adjustment capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to 22 seconds.
4. Deceleration: 2 to 22 seconds.
5. Current Limit: 50 to 110 percent of maximum rating.

L. Self-protection and reliability features include the following:

1. Input transient protection by means of surge suppressors.
2. Snubber networks to protect against malfunction due to system voltage transients.
5. Instantaneous overcurrent trip.
7. Reverse phase protection.
8. Under- and overvoltage trips.
10. Short-circuit protection.

M. Automatic Reset/Restart: Attempt 3 restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration will not damage controller, motor, or load.

N. Power-Interruption Protection: Prevents motor from reenergizing after a power interruption until motor has stopped.

O. Status Lights: Door-mounted LED indicators to indicate the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.


Q. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.

R. Automatic Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Bypass shall consist of a main power disconnect with ground fault protection, a pair of interlocked contactors and a motor overload relay. An Additional manual Controller-off-bypass selector switch indicator lights set and indicate mode selection.

S. Integral disconnect.

T. Isolating Switch: Non-load-break switch arranged to isolate variable-frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

U. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

V. The variable speed set control system and sequence is included in the BMS section.

2.8 FEEDER OVERCURRENT PROTECTION

A. Molded-Case Circuit Breaker: MCCB, handle lockable as mentioned and specified in main distribution board.

2.9 MCC CIRCUIT BREAKERS: MCCB below 800 Ampers and Air Circuit Breaker above 800 Ampers, both with utilization category “B” and electronic trip unit.
2.10 ACCESSORIES

A. Devices are factory installed in controller enclosure, unless otherwise indicated.


C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so a padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty with digital readout in hours.

F. Meters: Power meter.


H. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage. Provide adjustable response delay.

I. Transient Voltage Surge Suppressors: IEC 60364, IEC 61643-11, IEC 664-1 and IEC 1643-1, selected to meet requirements for a high-exposure category.

J. Impulse sparkover voltage coordinated with system circuit voltage.

K. Factory mounted with a Recognized Testing Laboratory listed and labeled mounting device.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.

D. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.2 INSTALLATION

A. Install motor-control centers according to accepted and manufacturer's written instructions.

B. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by tack welding or bolting. Level and grout sills flush with motor-control center mounting surface.

C. Install motor-control centers on concrete housekeeping bases. Height: 10 cm

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs according to Division 16, Section 16000, paragraph 1.6 K.

B. Identify field-installed wiring and components and provide warning.

C. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences, and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 16 Section "Wires and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices according to an indicated wiring diagram or one that is manufacturer approved, where available.

1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.5 CONNECTIONS

A. Tighten motor-control center bus joint, electrical connector, and terminal bolts according to manufacturer's published torque-tightening values. Such that system is type tested to IEC EN 60439-1.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor-control center and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in correspondence to IEC standards. Certify compliance with test parameters.
2. Remove and replace malfunctioning units with new units, and retest.

3.7 CLEANING

A. Inspect interior and exterior of motor-control centers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate solid-state and variable-speed controllers and motor-control centers, and train Owner's maintenance personnel.

1. Conduct a minimum of 4 hours of training in operation and maintenance. Include training relating to equipment operation and maintenance procedures.
2. Schedule training with at least 7 days' advance notice.
PANEL TESTING SOP

A. GENERAL
Standard industrial facility system start-up procedures must be followed to verify the mechanical and electrical integrity of building systems. It is not the intent of this document to provide operational instructions. Only standard start-up procedures will be described with supporting information to identify the logical sequences required.

The following general rules are assumed to be followed and form the basis of equipment start-up.

B. SUMMARY
Scope: Provide labor, material, equipment, related services, and required supervision.

C. REFERENCE
Publications listed in the specifications to the extent referenced shall be used to confirm compliance. Confirm that all work installed in conformity with all applicable local ordinances, state statues, factory mutual and IEC requirements. In case of conflict with any ordinance or statues, the governing requirements shall take precedence over the specified standards and codes.

D. SUBMITTALS
The contractors shall submit to construction manager reports of each test performed.

E. QUALITY ASSURANCE
1. Contractor’s Quality Assurance Responsibilities: The contractor shall be solely responsible for quality control of the work.
2. Qualifications: Start up services shall be performed by qualified personnel.

F. COORDINATION
The contractor shall coordinate and schedule all start up with the Owner, construction manager and all other contractors having involvement with the equipment before start up as appropriate.

G. PRE START UP PROCEDURES
1. Field verify the equipment installed is the equipment specified and is located in accordance with the drawings.
2. Inspect enclosures for fit and finish including, but not limited to, doors and covers.
3. Check cover plates, access covers, closing plates, knock out’s and doors are in place securely fastened or closed as required.
4. Inspect equipment components and subassemblies including, but not limited to, insulators, breakers and bus bars.
5. Check cable for proper torque and support. Any connections found to be loose shall be properly torque.
6. Inspect for any foreign materials that would impede proper ventilation and operation, violate clearance standards, or promote corrosion.
7. Visually check for proper ground connections per the manufacturer’s specifications.
8. Apply power to each unit and verify proper voltages, phase relationships, and absence of ground faults.
9. Ensure that circuits are not loaded over 80 per cent of their capacities.
10. Check equipment grounding. Tighten to assure permanent and effective grounds.
11. Inspect equipment for proper alignment, anchorage and seismic bracing where applicable.
12. Check with ground resistance tester phase to phase and phase to ground insulation resistance to ensure requirements is met.
13. Panel board, locks and trims shall be clean and adjusted to operate properly.
14. Lugs, bolts, clamps and screws shall be tightened.
15. Take action under the direction of the Construction Manager to correct any discrepancies found, whether due to equipment failure, misalignment, poor installation, blockages or interference, installation of the wrong item, or other conditions.
16. Provide all relevant test documentation.

H. SAFETY
All personnel involved in the inspection and operation of equipment shall be trained in the operation of such equipment and any required tooling or electrical test equipment. All personnel will comply with existing site and other applicable safety standards.

I. DOCUMENTATION
Documentation of procedures performed shall be provided. Copies shall be provided and delivered to the construction manager. Written documentation shall contain recorded values of electrical test performed per the individual product specifications.
Prior to the start of any start-up procedure, all electrical test and inspections shall have been performed and any discrepancies uncovered shall have been corrected and documented. Documentation to owner upon request.

The panel board starts up process should be documented using the checklist provided.

H. SHUTDOWN
Lock out main power disconnects to prevent starting.
DIVISION 17

LANDSCAPING, PLANTING AND ENVIRONMENTAL WORKS
SECTION 9.01 LANDSCAPING AND PLANTING

9.01.1 SCOPE

A. The work covered in this Section consists of the furnishing of all materials for and the construction, installation and completion of landscaping and planting.

B. Planting will generally be installed at locations within the right-of-way, such as earthwork slopes, interchange areas, median strips and areas set aside for pedestrians.

C. These works also include the preparation and submission to the Engineer for approval of all necessary working drawings and as-built drawings and all relevant literature, samples and certification of the quality of products.

D. Planting covers all items associated with preparing areas for planting and the transplanting and planting of trees, shrubs, ground cover, vines, grass, and turfing.

9.01.2 LANDSCAPE PLANTING STANDARDS

A. Planting shall conform to the relevant requirements of the following standards, unless otherwise indicated on the drawings or directed by the Engineer:

- "Grade and Standards for Nursery Trees - Part II: Palms and Trees", by Department of Agriculture, Florida, USA.
- BS 3882:1994 Topsoil
- BS 3936-1:1992 Nursery Stock, Trees and Shrubs
- BS 4428:1999 General Landscape Operations
- BS 4043:1989 Recommendations for Transplanting Root-Balled Trees
- ANSI: Z60-1 American Standards for Nursery Stock
- ASTM: C136-06 Standard Methods of Sieve and Screen Analysis of Fine and Coarse Aggregates
- ASTM: D422-63 Standard Method of Particle Size Analysis of Soils
- ASTM: D2607-69 Standard Classification of Peats, Mosses, Humus, and Related Products
- ASTM: D2974-00 Standard Method of Test for Moisture, Ash, and Organic Matter of Peat Materials
- ASTM: D2975-71 Standard Method of Test for Sand Content of Peat Materials
- ASTM: D2976-71 Standard Method of Test for pH of Peat Materials
- ASTM: D2977-03 Standard Method of Test for Practical Size Range of Peat Materials
B. The Contractor shall submit to the Engineer for approval, information and certification for all materials proposed for use in landscaping and planting. These shall include but not be limited to the following:

- Manufacturers' certified analysis of all standard products, including fertilizers
- Certificates confirming the origin, size and age of all plant material
- Health certificates for all imported plant material
- Manufacturers’ literature, samples and certified laboratory analysis of all recommended amendments to the planting soil mix.

C. The Contractor shall be responsible for the quality of all items purchased and shall submit an inspection plan for review. The inspection plan shall cover those items intended for shop inspection and the procedures for carrying out such inspections.

9.01.3 PRODUCTS AND MATERIALS

A. Agricultural Soil

A.1 Agricultural soil shall be obtained from well drained arable land approved by the Engineer before its use. It shall be free-draining, non-toxic and capable of sustaining healthy plant growth. Soil shall not contain subsoil, refuse, roots, heavy clay, noxious weed, phytotoxic materials, coarse sand, rocks, sticks, brush, litter or other deleterious materials.

A.2 Agricultural soil brought on to the Site without prior inspection and approval shall be at the risk of the Contractor, who shall remove it at his own expense if so instructed by the Engineer.
A.3 The Contractor shall arrange for physical and chemical analyses of representative samples of the soil to be made by a soil laboratory approved by the Engineer. Separate analyses shall be provided for each source of supply. The following parameters shall be determined and in the event that the soil does not conform to the following specified standards, it shall be liable to be rejected by the Engineer:

- Material passing No. 10 sieve: 100%
- Material passing No. 35 sieve: 9 - 100%
- Material passing No. 140 sieve: 0 - 10%
- Material passing No. 270 sieve: 0 - 3%
- Conductivity: less than 4 mm ms (micron second)/cm at 25 °C in an as-saturated soil extract (= 2,560 ppm)
- pH: pH 6.0 - 8.0 in a saturated soil extract
- Boron: less than 0.5 ppm in a hot saturated soil extract
- Chlorine (C1): less than 175 ppm in a saturated soil extract
- Exchangeable sodium percentage (ESP): less than 12%
- Sodium absorption ratio (SAR): less than 1
- Salinity (ECe x 1000): Less than 2

A.4 A sample load of agricultural soil of not less than 5 cubic metres from each source shall be submitted for approval by the Engineer. This sample, if approved, shall be retained for comparison with subsequent loads.

B. Organic Amendments

B.1 Peat humus shall be natural peat consisting of sedge, sphagnum or reed peat and shall pass through a 12 mm screen. Humus shall be free from sticks, stones, roots or other objectionable matter and shall have an acidity range between pH 3.7 and pH 5.5. The minimum organic content shall be 85% on a dry weight basis. Peat humus shall be delivered in undamaged commercial bales in an air-dry condition.
B.2 Shredded proprietary bark or equal coniferous bark shall be supplied in manufacturer's sealed containers and be nitrogen stabilized with the following chemical and physical characteristics.

- Material passing 9.51mm (3/8") sieve: 100%
- Material passing 6.35mm (1/4") sieve: 90 - 100%
- Material passing 2.38mm (No. 8) sieve: 50 - 60%
- Material passing 0.50mm (No. 35) sieve: 0 - 20%
- Bulk Density: 300 - 400 kg/m³
- Organic Matter: greater than 85%
- pH: 5.0 - 6.5
- Salinity (ECe x 1000): 0.5 - 2.0
- Total Nitrogen: 0.7 - 2.0
- Available Phosphorous: 100 - 500 ppm
- Cation Exchange Capacity CEC (meq/100g): 80 - 120 ppm
- Boron (by hot water extraction): less than 5 ppm
- Sodium Adsorption Ratio (SAR): less than 2.0

B.3 Shredded organic coniferous bark shall be a nitrogen stabilized material with the following chemical and physical characteristics:

- Particle size: 6 - 12 mm
- Bulk density: More than 300 kg/m³
- Organic matter: Greater than 85%
- pH: Less than 7.0
- Salinity (EC x 10³ at 25º C): Less than 1.0
- Total nitrogen: More than 0.5%
- Phosphorus: 100 - 500 ppm
- Cation exchange capacity: More than 80% meq/100 grams
- Boron: Less than 1.0 ppm hot water soluble
- Sodium Adsorption ratio (SAR): Less than 2.0

C. Fertilizers

C.1 Fertilizers shall be approved soluble NPK fertilizers in a suitable ratio applied at a dilution rate of one kg of fertilizer to 1,000 litres of water.

C.2 Proposals for use of any of the following alternative fertilizer types and composition where injection equipment is not specified for use shall be submitted the Engineer for approval. The suitable fertilizer type and grades shall be determined, after testing the soil samples, to suit the type of plantation:
C.2.1 Compound fertilizers applied at the rate of 12 bags per hectare giving N=100 Kg/ha; P2O5=150 Kg/ha; and K2O=100 Kg/ha

C.2.2 Single superphosphate fertilizers with a minimum content of 18% P2O5 applied at the rate of 2.4 kg/m³ of soil

C.2.3 Controlled release fertilizer with an NPK ratio of 16-17-5+Fe and a release period of 12-14 months at a 21°C soil temperature. Fertilizer planting tablets shall be tightly compressed fertilizer chips forming plant tablets, each weighing 20-22g.

C.2.4 Slow release compound fertilizer with a release longevity of 18-24 months comprised of:
- N: 6.5%
- P2O5 (soluble): 11.5%
- P2O5 (insoluble): 33.2%
- K2O5: 7.0%
- Mg: 11.8%

C.2.5 Nitrogen fertilizer in the form of urea pills containing 32% to 46% nitrogen.

D. Micronutrients

Micronutrients shall be copper sulphate, zinc sulphate, manganese sulphate, ferrous sulphate - FTE 503.

E. Sulphur

Sulphur shall be finely ground agricultural sulphur of not less than 90% purity.

F. Planting Medium

F.1 Planting medium shall conform to the following requirements:
- Salinity (ECe x 1000): less than 4.0
- SAR: less than 4.0
- pH: 6.5 to 7.5
- Boron (by saturation extract): less than 1.0 ppm
F.2 Planting medium for all planting operations shall contain the following ingredients in the ratios by volume, thoroughly mixed with fertilizers and approved by the Engineer:
- 6 parts agricultural soil
- 2 parts organic Amendment as described above
- 10 Kg/m³ organic fertilizer
- 2.5 Kg/m³ of agricultural grade soil sulphur if organic fertilizer is not available and if approved by the Engineer.

G. Mulch

Stone mulch shall consist of washed gravel, 20-30 mm in size, free from dirt, organic matter, clays, clay film or other deleterious matter. The stone shall be of a consistent colour, texture and type throughout. Samples of stone mulch shall be submitted to the Engineer for approval prior to use in the Works.

H. Plants

H.1 All plants shall comply with BS 3936-1:1992 and be of the size specified. No plant shall be less than the minimum size and at least 50% shall be in the upper part of the specified range. Plants that meet the measurements specified but do not possess the normal balance between height and spread shall not be accepted.

H.2 All planting stock shall be well-balanced and well formed, sound, vigorous, healthy and free from disease, sunscald, abrasion, harmful insects or insect eggs and with a healthy, unbroken root system. Unless otherwise approved by the Engineer, only nursery-grown plants shall be used.

H.3 Nomenclature of trees and plants shall conform to the scientific names given in the following books. Alternative names shall be checked in these books to confirm that plants agree with the botanical description given:
- American Joint Committee on Horticultural Nomenclature (AJCHN) - "Standardized Plant Names"
- Royal Horticultural Society - "Directory of Gardening"
- Post, George E., "Flora of Syria, Palestine and Sinai", American University of Beirut.
- Sunset Western Garden Book, Current Edition

H.4 All plants supplied shall have been grown from the Contractor's own nursery stock or obtained from a reputable nursery and shall be subject to approval by the Engineer at the source prior to transport to Site.
H.5 If specified plants are unobtainable substitutions proposed by the Contractor shall be subject to approval by the Engineer.

I. Trees

I.1 Trees shall be symmetrically developed, grown in conditions appropriate to the species with straight stems and an intact central leader. All trees shall be root-pruned at source prior to shipment to the Project site and shall be supplied with an earthball in either a hessian cover or a suitable container. Bare root trees shall not be acceptable without the prior approval of the Engineer. The acceptable minimum tree sizes shall be as indicated on the Drawings or as instructed by the Engineer.

I.2 Where the required tree sizes are unobtainable, upon the submission of evidence to that effect, the Contractor shall, if approved by the Engineer, substitute suitable tree species.

I.3 Anti-desiccant shall be applied to all trees less than 24 hours prior to shipment from the source to the Project site. A sample of the anti-desiccant in the manufacturer’s unopened container shall be submitted to the Engineer for approval prior to its application.

J. Palms

J.1 Palms shall be balled and burlapped or container grown. Offshoots shall not be accepted. Palms shall have a vigorous root system, a crown of new leaves and be of sufficient hardiness. Fronds shall exhibit no signs of moisture stress. All palms shall have straight trunks. Any tree having a weak or thin trunk not capable of supporting itself when planted in the open shall not be accepted.

J.2 The minimum height of palms shall be as specified on Drawings or as instructed by the Engineer.

J.3 Palm trees shall be root-pruned one year before removal from the original growing site. The pruning trench shall be backfilled with wet peat or other material approved by the Engineer and the tree sprayed with anti-desiccant.

J.4 Palms shall be dug and prepared for shipment using a method that will not cause any damage to the fronds, bud, shape, root system and future development of the plants after replanting.
J.5 All suckers and flowering and fruiting parts and approximately one third of fronds shall be removed prior to digging. A minimum of 20 fronds, sufficient to enclose and protect the growing bud, shall be lifted upward to surround the growing bud, trimmed to two-thirds of their original length, wrapped and securely tied with burlap. Tree bud splints padded with burlap shall be placed along each of two sides of the wrapped fronds and firmly wired in place during all diggings, transporting and planting operations. A minimum of five wooden battens per tree (1 cm by 6 cm by 60 cm) shall be adequately padded with several layers of burlap and be firmly wired in place around the trunk for protection from lifting devices during digging, transporting and planting operations. Nailing of battens to the trunk shall not be permitted. The roots shall be balled and hessian tied. All palm rootballs shall be dusted with sulphur powder prior to planting or heeling in on Site.

J.6 All palms shall be shipped under covers. Transportation shall not exceed 24 hours from time of loading to arrival at the Site. The palms shall be transported and handled in accordance with the following:

- When the palms are ready to be shipped, the palms shall be stored horizontally on a level surface with the fronds wrapped tight. At least three layers of burlap shall be used.
- The rootball shall be wrapped with a minimum of four layers of burlap, saturated with water and covered. The burlap shall be periodically watered to keep it moist at all times.
- The growth bud shall not be damaged.
- The trunk of the palm shall not be watered.
- Only sharp tools shall be used for cutting and trimming.
- A bed of 150mm of moist organic amendment shall be placed on the floor of the transport. The palms shall be hoisted by slings and placed horizontally on the bed of the truck. They shall be nested carefully in head to toe. Moist burlap shall be placed over the roots.
- The entire load shall be covered with two layers of tarpaulin. The palms shall be secured to prevent wind from lifting the tarpaulin and drying the palms.
- The palms shall be loaded and unloaded using nylon or canvas slings.
- Before planting on Site the roots shall be trimmed with a sharp knife to prevent mashing. The remaining roots shall have over 100 millimetres of living tissue.

J.7 If temporary heeling in at the Project site is necessary prior to final planting, palms shall be planted to a depth of 200 mm above the top of the existing rootball.

J.8 The rootball shall be planted intact and the terminal bud undamaged. Damaged palms shall be replaced at the Contractor's expense.

J.9 Guying of the palm trees shall be as specified on the Drawings or as instructed by the Engineer.
J.10 Palms shall be irrigated and basins prepared to retain the water. The Contractor shall provide a sub-soil drainage system to the palm growing area.

J.11 The Contractor shall replace, at his own expense, planting material that does not grow and fails to survive while in the site nursery or holding area. All plants that show signs of failure to grow, as determined by the Engineer, shall be removed and replaced. The Engineer shall inspect the nursery growing grounds once a week or at longer intervals, at his discretion and will mark or indicate the plants to be replaced. Any plant requiring replacement shall be replaced with a plant of equal size and age at the date of replacement. Replacement, removal, transporting and installing of the plants shall be undertaken by the Contractor at his own expense.

J.12 If the palms have been temporarily heeled-in or held in a project nursery for more than 45 days, the following procedures shall be followed immediately prior to relocation for final planting:

- Trim off matured fronds using a very sharp knife.
- Trim semi-mature fronds but leave a total of 10 to 14 fronds, either mature or semi-mature, to protect the growth bud.
- Trim off all suckers and fruiting stalks.
- The remaining fronds shall be tied upright with twine to surround the growth bud. The fronds shall be then trimmed to about 2/3 of their original length. These tied fronds shall then be neatly wrapped with burlap and retied to hold the burlap in place.
- After wrapping fronds, the soil around the palm tree shall be watered to field capacity. The palm shall not be dug until the soil is in a friable condition. If the palms remain in the ground in a wrapped condition for more than two days the watering procedure shall be repeated daily.
- Excavate a trench approximately one metre from the trunk to a depth of 1.25 metres. Break the rootball loose from the ground by prying. (Use of a backhoe to excavate around or to remove the palm is permissible). Care shall be taken to avoid bumping the palm near the growth bud.
- Use a front loader, backhoe or crane and a heavy duty nylon or canvas sling to lift the palm vertically from the pit. With the palms suspended in the vertical position, using sharp machetes, shovels and shears, remove all the dirt and trim the roots to 0.50 metres from the trunk.

K. Shrubs

Shrubs shall have a minimum height as specified on the Drawings or instructed by the Engineer. The shrubs shall be in good condition, well grown and bushy. Deciduous shrubs shall be supplied bare-rooted, earth-balled and hessian covered or container-grown. Evergreen shrubs shall be either earth-balled or container-grown. Each shrub shall possess a structure and growth typical of the species or variety.
L. **Vines, Climbing Plants, Ground Cover and Succulents**

**L.1** Vines, ground cover and succulent plants shall be well rooted and of not less than one year's full growth and fully acclimatized to outside conditions if pot grown. Before delivery to Site, all plants (other than succulents) shall be dipped in an anti-desiccant.

**L.2** Climbing plants shall have a minimum of 3 leading shoots, each at least 0.75 metres in length. Growth shall be symmetrical and balanced. They shall have been grown in containers for at least one year.

M. **Tree Stakes and Ties (Excluding Palm Stakes)**

**M.1** All stakes shall be of timber or mild steel.

**M.2** Timber stakes shall be straight, free of projections and pointed at one end. The base ends shall be coated with a non-injurious wood preservative to a minimum height of 0.15 metres below ground level, applied at least 2 weeks before use.

**M.3** Mild steel stakes shall be protected by a PVC coating in mid-green or a similar colour. The tops and bottoms of the steel tubes shall be sealed with plastic caps. The external covering shall have horizontal ridges at regular intervals to facilitate the fixing of tree ties. Stakes and tie rods shall be 15mm diameter and steel tubes shall have an external diameter of 35 mm.

**M.4** The length of stakes shall be a minimum of 30 cm below ground and to the full height of the stem or half-full height for feathered species.

**M.5** Wooden and steel stakes shall not be used on the same site.

**M.6** Tree ties shall consist of synthetic rubber compound hose, plastic adjustable straps or neoprene tube approximately 30 mm in diameter and 300 mm in length with rubber or hessian buffers.

N. **Guy Wires for Trees and Palms**

**N.1** Where specified on the Drawings or instructed by the Engineer, trees and palms shall be stabilized with three 7-strand galvanized guy wires of 6 mm diameter and of a length suited to each tree, fixed to a position approximately two thirds of the tree height. The wire guy shall be looped around the trunk or palm stem and protected by suitable tree ties.

**N.2** Each guy wire shall be connected via a 50 mm galvanized turnbuckle to a 150 mm malleable iron ground anchor fixed by 1.2 metre long drive rods.
O. Trunk Wrapping Material

Trunk wrapping material shall be either hessian bands 75 mm wide and of lengths as necessary for wrapping tree trunks and main branches or purpose made, double thickness heavy crepe paper in rolls not less than 100 mm wide with a stretch factor of 33 %.

P. Burlap

Burlap shall be jute of 0.20 kg/m² or cloth having the same strength and resistance to tearing and capable of rotting in the ground.

Q. Twine for Tying

Twine for tying shall be lightly tarred medium or coarse sisal yarn.

R. Plant Labels

Plant labels shall be durable, weatherproof and shall state legibly the correct plant name and size.

S. Precast Concrete Tree Grate

Precast concrete grates for sidewalk tree planting shall be as shown on the Drawings or as instructed by the Engineer.

V. Metal Tree Guards

Metal tree guards shall be green in colour and of sizes as indicated on the Drawings or instructed by the Engineer.

W. Chafing Guards

Chafing guards shall be two-ply reinforced rubber or plastic garden hose of a uniform colour throughout the site.

X. Wire Mesh

Welded wire mesh shall be galvanized and with a minimum diameter of 1.5 mm

9.01.4 LANDSCAPE PLANTING CONSTRUCTION

A. General

A.1 Agricultural soil and planting medium shall not be brought to the Site or spread when in an excessively wet condition.
A.2 Planting shall be carried out in accordance with the Drawings and shall be liable to in situ adjustments as required. Planting areas and tree pits shall be measured and staked out for approval before starting the planting.

A.3 All imported plants shall be seasoned to site conditions for the appropriate length of time for the species and in the season before planting. Conditioning time shall be a minimum of 10 weeks for autumn planting and 6 weeks for spring planting.

A.4 All work shall be carried out during the appropriate season and in weather conditions suitable for the operation. Planting shall not be carried out before October or after March, except for large palms which shall be planted during the period of optimum root growth from mid April to the end of September.

A.5 All operations shall be executed by suitable plant approved by the Engineer or by hand. Work in confined spaces, around existing trees or in the vicinity of major utilities shall be executed by hand.

A.6 Existing trees, shrubs or other plants shall not be removed without approval. The Contractor shall protect all plants from malicious or accidental damage and shall ensure that no branches are lopped and no tree roots exceeding 50 mm in diameter are severed from growing trees except for pruning and training operations. Soil, spoil, construction material or rubbish shall not be stored or deposited within 3 metres of existing trees, shrubs or hedges. No fires shall be lit within the landscape boundaries. Any damage shall be made good by the Contractor at his own expense.

A.7 Transplanting shall consist of immediate replanting of vegetation on site, where shown on the Drawings. If the season of works does not coincide with a favourable time for transplanting, the plants shall be tended in containers in a nursery at the expense of the Contractor until, in the opinion of the Engineer, conditions are favourable.

A.8 Before commencement of transplanting, the Contractor shall inspect all plants and report to the Engineer any problems. The Contractor shall submit for the Engineer’s approval a method statement regarding the planting processes and equipment to be used. Notice shall be given by the Contractor to the Engineer prior to the start of transplanting.

B. Storage Requirements

B.1 All materials to be used in landscaping and stored at the Contractor's yard shall be kept covered and protected. Any plants held shall be kept in a special compound, sheltered from direct sunlight and drying winds and watered regularly.

B.2 Agricultural soil shall be stored in heaps no higher than 1.5 m and shall be protected from undue compaction.
B.3 All oil and petrol containers shall be stored in suitable sheds provided by the Contractor who shall observe all regulations regarding the storage of flammable liquids. If any areas of soil are affected by oil or petrol spillage, all contaminated soil shall be dug up and carted away and such areas made good as directed by the Engineer at the Contractor's expense.

B.4 The Contractor shall ensure that all chemicals are stored, handled and supplied strictly in accordance with the manufacturer's instructions. All chemicals in the dosages specified shall be non-toxic to humans, birds and animals and be approved for use in the Works.

C. Soil Grading and Preparation

C.1 Subsoil shall be excavated to achieve the tolerances specified for the finished levels of soil and when reasonably dry and workable, graded to smooth, flowing contours with all minor hollows and ridges removed. Non cohesive, light subsoils shall be loosened with a plough, to a depth of 300 mm at one metre centres. All perennial weeds shall be treated with herbicides and the period of time recommended by the herbicide manufacturer shall be allowed to elapse before grading.

C.2 Finished ground levels of soil areas shall be 30 mm below the adjoining paved areas or kerbs after settlement, except for any median strip where New Jersey barriers are specified, in which case the finished level shall be as shown on the Drawings or directed by the Engineer. Finished ground levels adjoining buildings shall be 150 mm below the level of the damp-proof course.

C.3 Areas to be grassed shall be excavated to 200 mm below finished levels and shall be brought up to finished levels using agricultural soil. When reasonably dry and workable, the agricultural soil shall be graded to the finished grade with all minor hollows and ridges removed.

C.4 Areas for shrubs shall be cultivated to a depth of 400 mm and brought up to within 100 mm below finished grade. Planting medium shall be spread evenly over planting areas to a depth of 100 mm prior to planting.

C.5 All weeds, rocks and other debris shall be removed and disposed of and the Contractor shall ensure that all planting positions are well drained.

D. Planting Procedures

D.1 The outline of landscape planting areas shall be staked out for approval by the Engineer. Agricultural soil shall then be supplied and spread over planted areas.
D.2 Tree, shrub and other planting positions shall then be staked out for approval by the Engineer. Planting pits shall be excavated to the sizes specified and excavated subsoil removed from the Site. Each planting pit shall be filled with water to ensure that the adequately drained. Stakes shall be driven where specified, a layer of planting medium spread over the bottom of each pit and lightly tramped and each plant positioned and surrounded with planting medium. Plants shall be tied to stakes and stone mulch spread as specified.

D.3 All plants shall be checked one week after planting for signs of wind shake and loosening due to soil subsidence and shall be made good as necessary. All plants shall thereafter be checked at monthly intervals until the end of either the specified Maintenance Period or Defects Liability Period, whichever is the later.

D.5 Wrapping shall be removed from the buds of palm trees after completion of all planting operations.

E. Preparation of Planting Medium

Planting medium shall be mixed thoroughly before placing in planting pits or on planted areas. The Engineer shall be present during the production of prepared planting medium.

F. Planting Trees and Palms

F.1 Planting of trees and palms shall be in accordance to the requirements of BS 3998:1999 and BS 4043:1989 as applicable.

F.2 Tree pits shall be excavated one metre square to a depth one metre below finished grade and pit bases shall be broken up to an additional depth of 300 mm. Excavated material unsuitable for re-use shall be disposed of.

F.3 Before planting, any broken or damaged roots shall be cut back to sound growth and any cut ends over 25 mm in diameter shall be treated with tree wound dressing.

F.4 For bare-rooted trees, backfill shall be placed in 150 mm to 250 mm layers to ensure close contact with roots and to eliminate air pockets. Firming shall take place as backfilling proceeds to prevent damage to roots and the soil shall be heeled-in firmly around the root collar. For root-balled trees, backfill shall be firmed around the root-ball in 150 mm layers to minimise disturbance to the roots.

F.5 Where long-term fertilization of trees and palms is specified or required by the Engineer, slow-release tablet fertilizer shall be placed around each root-ball after half of the planting medium has been placed. Tablets shall be placed around the pit perimeter, equally spaced at the rate dosage in accordance with the manufacturer’s instructions.

F.6 Before lifting from the original position the north side of trees shall be marked to ensure that orientations are the same for replanting.
F.7  Trees shall be placed centrally in the pits and at the original soil depth and watered thoroughly after backfilling. A water-holding depression 150 mm deep and 0.6 m minimum diameter shall be excavated around each tree.

F.8  For semi-mature trees, trunks and lower branches shall be wrapped with hessian strips, straw ropes or treated crepe paper.

F.9  Suckers, flowering and fruiting parts and approximately 30% of fronds of palm trees shall be removed before planting. Sufficient fronds, burlap wrapped and securely tied in position, shall be left to enclose and protect growing buds and for around one year after planting. Palm roots shall be protected from bruising during burlapping and planting. Trunk burlap, frond wrapping and dead fronds shall be removed after new growth indicates that turgor has been restored or after the second growing season.

F.10  Conifers and evergreens shall be dipped or sprayed with anti-desiccant before delivery to site and again after planting. Anti-desiccant shall not be applied in wet weather.

F.11  Trees shall be thoroughly watered immediately after planting using a fine spray hose.

F.12  After watering and within 48 hours of planting 300 grammes of inorganic fertilizer shall be spread over the tree or palm pit area.

G.  Staking and Tying Trees and Palms

G.1  For standard trees, two stakes shall be inserted into the tree pit with a minimum of one third of the length below ground level. For root-balled trees and those in containers, a crowbar or similar tool shall be used to probe through the root system and make a pilot hole into which the stakes can be driven with minimum root disturbance. The tree shall be secured firmly, but not rigidly, to the stakes with at least two ties each, to prevent abrasion between the stakes and the tree. The top ties shall be positioned 25 mm from the top of the stakes and the lower ties approximately halfway down. One end shall surround the tree trunk while the other end shall be connected to the supporting stake located in the opposite direction of the prevailing wind and at a minimum distance of 30 cm.

G.2  For heavy standard trees, 3 stakes shall be inserted into the tree pit equidistantly around the tree trunk with a minimum of one third of the length of each stake below ground level. For root-balled trees and for those in mesh containers the stakes shall be driven clear of the root-ball to avoid damage to the root system. The tree shall be secured firmly, but not rigidly, with proprietary ties approved by the Engineer.

G.3  Palms shall be supported with either three equally spaced stakes or three guy wires secured to ground anchors and attached to palms at approximately two-thirds height. Tension shall be adjusted as necessary with turn buckles.
G.4 Chafing guards shall be used between trees or palms and stakes.

G.5 Split stakes shall be replaced. Snags and burrs which may cause chafing of trees shall be removed.

H. Planting Shrubs and Ground Cover

H.1 Plants shall be dipped in anti-desiccant before delivery to site and sprayed with anti-desiccant soon after planting. Spraying shall not proceed in wet weather.

H.2 Holes for plants, including shrubs and ground cover, shall be excavated to a depth of 0.5 m below finished grade and to a diameter of 0.5 m. If the root-ball, container or root system is too big to prevent appropriate backfilling the dimensions of the hole shall be increased accordingly.

H.3 Shrubs shall be planted upright and well balanced with their best sides to the front. Holes shall be backfilled with planting soil, packed around evenly spread roots or the root-ball, and heeled in. The finished level shall be at the original soil mark on shrubs and 30 mm above the surrounding level to allow for settlement.

H.4 Plants shall be set plumb and to the same depth as in the nursery.

H.5 Earth-balled hessian-covered plants shall have all cloth and ties removed from the tops of the earth-balls but not from their undersides.

H.6 Disturbance of the root system or the balls of earth shall be avoided when removing plants from containers. Cutters shall be used on metal containers.

H.7 Bare-rooted plants and plants with broken root-balls that fall apart while being planted shall not be accepted.

H.8 Prepared planting medium shall be carefully packed around each root-ball in 150 mm layers and well heeled-in to position the plant and eliminate air pockets.

H.9 Where long term fertilization of shrubs is specified or required by the Engineer, slow release fertilizer tablets shall be placed during shrub planting as specified for trees and palms.

H.10 Each plant shall be thoroughly watered when the plant area has been backfilled with planting medium to the base of the root-ball. When the water has drained away completely, backfilling shall be completed and the plant re-watered.

H.11 After watering and within 48 hours of planting, inorganic fertilizer shall be spread over the planting area at the rate of 50 g/m².

H.12 Climbing plants shall have their leading shoots trained around the supporting wire mesh.
I. **Pruning**

Immediately after planting, all plants shall be pruned as directed and in accordance with accepted horticultural practices. Pruning shall consist of carefully cutting back any damaged, dead or diseased branches and removal of any weak or malformed growth. All pruning cuts greater than 200 mm shall be treated with a tree wound dressing approved by the Engineer.

J. **Raking**

Soil shall be forked and/or raked into a fine tilth after planting.

K. **Placing Stone, Vegetable and Wood Bark Mulch**

Mulch shall be laid sequentially with the plant material to a thickness of 75 mm and shall be kept away from all drain inlets and all pedestrian and vehicular areas.

L. **Cleaning Up**

Soil shall be removed from hard surfaces and grassed areas and the works left in a clean and tidy condition.

M. **Labels**

Plastic labels, clearly marked with species and variety, shall be attached to each tree, shrub and plant.

N. **Watering and Protection of Trees and Plants**

The Contractor shall ensure that sufficient water is applied to maintain healthy growth of all trees and plants.

T. **"As-Built" Drawings**

Promptly upon completion of all landscaping works, the Contractor shall furnish the Engineer with 3 bound sets of 'as-built' Drawings which shall include the names and accurate locations of all species installed in all the planted areas.

U. **Maintenance of Palms, Trees, Shrubs, Ground and Vines**

   **U.1** Trees, shrubs or plants found to be dead or in an unhealthy condition during the Defects Liability Period shall be removed and replaced with approved equivalent trees, shrubs or plants, unless otherwise instructed by the Engineer. Replacements shall be planted during the growing season following the end of the Defects Liability Period.
U.2 The Contractor shall regularly inspect and maintain the planted areas from the date of provisional acceptance by the Engineer on completion of initial planting until the end of the Defects Liability Period.

U.3 The Contractor shall ensure that sufficient water is applied to maintain healthy growth of trees, shrubs and plants using fine hoses or sprinklers until topsoil is saturated. Tree crowns shall be sprayed in the evenings when in leaf during warm weather.

U.4 Beds shall be kept clear of weeds by cultivation and the use of herbicides approved by the Engineer. Soil in plant beds shall be periodically loosened to the approved camber and with no hollows.

U.5 At the start of each growing season the Contractor shall spread inorganic fertilizer over all planted areas and tree pits at the rate of 50 g/m² for planted areas and 300 g/m² for areas planted with trees.

U.6 Plants shall be pruned at appropriate time to remove dead, dying and diseased wood and suckers to promote healthy growth and maintain a natural shape. Cut ends exceeding 25 mm diameter shall be dressed with tree wound dressing.

U.7 Burlap wrapping shall be removed from palm growing buds when the turgor in the buds has been completely restored.

U.8 The Contractor shall check the condition of stakes, ties and guards, replacing broken or missing items. Ties shall be adjusted if necessary to prevent rubbing of bark. Damaged bark shall be cut out and treated with tree wound dressing.

9.01.5 MEASUREMENT

A. Transplanting trees and palms shall be measured by the number of each type transplanted including excavation, planting in temporary containers, transportation, preparation of planting areas, agricultural soil, stone mulch filling, planting medium, staking, replanting, root treatment, pruning, labelling, shaping, protecting and all ancillary works needed including the necessary maintenance and replacement.

B. Trees, Palms, Shrubs, Ground Cover, Succulents and Climbing Plants shall be measured by the number of each type furnished, installed, including preparation of planting areas, transportation and all necessary agricultural soil, planting medium, fertilizers, staking, tying and incidentals, and accepted.

C. Mulches shall be measured by the cubic metre furnished, laid and accepted.

D. Additional fertilizer approved by the Engineer for use, shall be measured by the kilogram furnished, incorporated in the Works and accepted.
E. Unless otherwise indicated in the Bill of Quantities, agricultural soil used for planting of trees and shrubs shall not be measured for direct payment but shall be deemed to be included in the rate of Tree’s planting item.

F. Agricultural soil used for landscape areas other than for trees and shrubs shall be measured by the cubic metre, completed and accepted, including excavation, transportation, storing, and all other items necessary for the completion of the works.

G. Grass seeding and grass turfing shall be paid by the square metre, supplied, applied at the specified rate or laid, protected, watered and cut twice a year in the growing season until the end of the Defects Liability Period, all in accordance with the Drawings or specified by the Engineer.

H. The following items are deemed to be included in the relevant prices for landscaping works and shall not be paid for separately:

- Compliance with the Drawings.
- Submission of a detailed programme of works and methodology.
- Specifying topsoil mix(es) to be followed subject to Engineer’s approval.
- Preparation of all submittals, execution drawings subject to Engineer’s consent and as per detailed drawing.
- The furnishing of labour and plant to complete the landscaping work
- Site nursery costs.
- Cultivation and weeding of soil.
- Applying fertilizers after planting.
- Watering until the end of the Defects Liability Period.

E. The maintenance of all plants shall be the responsibility of the Contractor until the end of the Defects Liability Period. All maintenance costs are deemed to be included in the relevant prices for landscaping works and shall not be paid for separately. These include:

- Provision of all fertilizers.
- Pesticide applications
- Pruning, shaping and trimming plants.
- Irrigation, soil scarification, and weeding,
- Grass cutting
- Replacing dead, disfigured and diseased plants, shrubs and trees