

الجمهورية اللبنانية

مجلس الانماء والاعمار

بيروت - لبنان

REPUBLIC OF LEBANON
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION
BEIRUT - LEBANON

CHHIM GOVERNMENTAL OFFICES BUILDING
(PHASE 2)

SPECIFICATIONS
FOR
STRUCTURAL (for info)
ARCHITECTURAL WORKS & LIFTS
VOLUME 2 OF 5

OCTOBER 2025



خطيب و علمي
شركة الاتحاد الهندسي
Khatib & Alami
consolidated engineering company

CHHIM GOVERNMENTAL OFFICES BUILDING

CHHIM, SHOUF - LEBANON

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DIVISION 1

GENERAL REQUIREMENTS

DIVISION 01

GENERAL REQUIREMENTS

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SUMMARY OF WORK (01010)

A. **Scope**

This Specification covers the construction and completion of "*Chhim Governmental Offices Building*" as shown on the Drawings and as detailed in the Contract Documents and/or as directed by the Engineer.

The Contract comprises the execution and completion of the works and remedying any defects therein including the provision of all labour, materials, constructional plant, temporary Works and everything whether of a temporary or permanent nature required for the execution and completion of the works.

The organisation of the Specifications into Divisions, Sections and Paragraphs and the arrangement of Drawings shall not necessarily control the Contractor in dividing the Work among sub-contractors or in establishing the extent of Work to be performed by any trade.

In examining the requirements of any Section of the Specifications the Contractor shall examine all other Sections of the Specifications and the other Documents and Drawings which affect the Work of that Section.

B. **Performance and Standards**

The performance required of materials and products and the standards to be complied with are specified in subsequent Sections of the Specification.

C. **Related Items**

01015 Contractor's Use of Site

CONTRACTOR'S USE OF SITE (01015)

A. **Scope**

1. This Section generally specifies administrative and procedure requirements regarding the Contractors Use of Site. Additional requirements are specified in various Sections of the specifications and also may be required during the execution of the work due to project conditions.
2. Requirements of this Section shall include, but not be limited to the following:
 - a. Procedures for use of site.
 - b. Coordination.
3. THE REQUIREMENTS OF THIS SECTION DO NOT SUPERSEDE OR TAKE PRECEDENCE OVER ANY PROVISION OF THE GENERAL CONDITIONS OF CONTRACT.

B. **Performance and Standards**

1. Work required to meet the requirements of this Section shall be performed in accordance with the General Requirements “Site Administration, Regulations, Safety, Health And Environmental Regulations” as published in this book and other General Requirements of Local Authorities having jurisdiction. In the event of conflicts between the General Requirements of this Section, Project Conditions or Employer's Requirements, the Contractor shall notify the Engineer, in writing, and the Engineer shall interpret and decide such matters in accordance with applicable provisions of the Conditions of Contract.
2. The Contractor shall obtain all necessary approval from Local Authorities having jurisdiction before starting any connection works to the Infrastructure.

C. **Related Items**

01010 Summary of Work

D. **Submittals**

1. The Contractor shall submit drawings of access roads, staging and storage areas and site controls.

CONTRACTOR'S USE OF SITE (01015) (CONT'D)

E. Use of Site

1. All construction operations and site establishment facilities shall be confined to within the Site Boundaries unless otherwise agreed with the Engineer and the Employer.
2. The Contractor shall be responsible for safeguarding all existing structures.
3. The Contractor shall be responsible for arranging his own working space, storage of materials, setting of all temporary accommodations, parking for vehicles, workshops, temporary utility, services and other facilities etc.
4. The Contractor shall keep driveways and entrances serving the premises clear and available to the Employer, the Employer's employees and emergency vehicles at all times. The Contractor shall not use these areas for parking or storage of materials and must schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
5. The Contractor shall not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas proposed by the Contractor at Tender stage, after having received the approval of the Engineer. If additional storage is necessary, the Contractor shall arrange for such storage off site at no additional cost to the Employer.
6. The Contractor shall lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. The Contractor shall not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

F. Coordination

1. The Contractor shall be responsible to coordinate the Conveying Systems, Mechanical and Electrical Works as specified in Divisions 14, 15 and 16.
2. The Contractor shall ensure that the Conveying Systems, Mechanical and Electrical Works are carried out in proper sequence having regard to the progress of the works, and that all necessary provisions are made for locating, routing, supporting and fixing the engineering services, providing the necessary holes, chases, embedded items and access for them, and in all respects fully integrating them with the building structure and the infrastructure.

FIELD ENGINEERING (01050)

A. **Scope**

This Section covers:

1. Survey and field engineering, quality control, submittals and project record documents of the Works.
2. The Contractor's responsibility for the accurate setting out of the Works both on drawings and on Site.

B. **Related Items**

01700 Execution Requirements: Project Record Documents

C. **Performance and Standards**

Employ a Certified Land Surveyor acceptable to the Engineer to perform survey work of this Section.

All setting out, including the setting out and marking of builder's work requirements shall be measured from agreed data.

D. **Submittals**

The Contractor shall:

1. Submit name, address, and telephone number of Surveyor before starting survey work.
2. Submit survey data for all columns' sizes and locations, in all floors, verifying accuracy of plans provided. Indicate to the engineer discrepancies to be corrected. No construction will be allowed before providing the survey.
3. On request, submit documentation verifying accuracy of survey work.
4. Submit a copy of site drawing signed by the Certified Land Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.
5. Maintain a complete and accurate log of control and survey work as it progresses.

FIELD ENGINEERING (01050) (CONT'D)

E. **Examination**

1. The Contractor shall verify locations of survey control points prior to starting work.
2. The Contractor shall promptly notify the Engineer of any discrepancies discovered.

F. **Survey Reference Points**

1. The Contractor will locate and protect survey control and reference points.
2. The control datum for survey is that indicated on Drawings or as given by the Engineer.

G. **Survey Requirements**

The Contractor shall:

1. Provide field engineering services. Utilize recognized engineering survey practices.
2. Establish a minimum of four permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
3. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - a. Site improvements including pavements; stakes for grading; utility locations, slopes, and invert elevations.
 - b. Grid or axis for structures of existing and new structures.
 - c. Column locations, ground floor elevations, and roof elevation of existing and new structure.
4. Periodically verify layouts by same means.

H. **Existing Levels**

The Contractor shall satisfy himself that the levels as shown on the drawings are correct. Should the Contractor wish to dispute any levels he shall submit to the Engineer a schedule of the position of the levels considered to be in error and a set of revised levels. Levels shall not be disturbed during execution without the approval of the Engineer.

Claims brought on discrepancies due to non compliance by the Contractor of the aforementioned shall not be considered.

REGULATORY REQUIREMENTS (01060)

A. **Scope**

This Specification calls attention to the regulations to be observed by the Contractor, and the Standards and Codes of Practice to which reference shall be made.

B. **Regulations**

The Contractor shall carry out the Works in full observance of Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction.

C. **Standards**

1. Notwithstanding the Specification of certain Standards and Codes of Practice, all Materials, Products and Workmanship shall comply with the requirements of the latest edition of all relevant and current Standards, Codes of Practice and all current amendments thereto.
2. Compliance shall be understood to mean that the standard attained shall not be less than that specified in the Standard or Code of Practice and may well be higher. In particular, where a higher standard is called for in the Specification that higher standard shall take precedence over the relevant Standard and Code of Practice, even if these are referred to in the text of the Specification.
3. In the case of materials and products which have been produced or manufactured in accordance with a published Standard or Code of Practice, that fact shall be brought to the attention of the Engineer together with full particulars of the standard in question which will be accepted by the Engineer if he is satisfied as to its provisions.

MANAGEMENT AND ADMINISTRATION PROCEDURES (01100)

A Superintendence

The Contractor shall accept responsibility for coordination, superintendence and administration of the Work, including all sub-contracts.

The Contractor shall arrange and monitor a programme with each sub-contractor, supplier and local authority and obtain and supply information as necessary for coordination of the Work.

B Insurances

Before starting Work on site, the Contractor shall submit to the Employer documentary evidence and/or policies and receipts for insurances which are required to be taken out by the Contractor.

C Insurance Claims

If any event occurs which may give rise to any claim or proceeding in respect of loss or damage to the Works, or injury or damage to persons or property arising out of the Works, the Contractor shall forthwith give notice in writing to the Employer and the Insurers. The Contractor shall indemnify the Employer against any loss which may be caused by the Contractor's failure to give such notice.

D Permits and Fees

Before commencing Work on site the Contractor shall give all notices, obtain all permits and pay all fees statutorily required in connection with Engineers and Contractors Site Accommodation, fencing and services connections.

The Contractor shall be responsible for the renewal of any of the above notices, permits and payment of additional fees as required during the contract period.

The Contractor shall also obtain any Bank Guarantees required by the Municipality, Government Ministries, etc, in connection with the above. All pertinent correspondence and documents relevant to the giving of notices and payment of fees shall be copied to the Engineer.

MANAGEMENT AND ADMINISTRATION PROCEDURES (01100) (CONT'D)

E Checklist Systems

The Engineer will require the use of checklist systems for the proper implementation and recording of quality control and for testing and observations carried out by him on site. Implement a checklist system to the Engineer's approval and abide by and adhere to these procedures.

F Project Control System

As part of the Contractor's overall project control, he shall utilize the latest versions of the following computer software when producing his reports, submissions or the like:

1. Primavera
2. Expedition
3. MS Project
4. AutoCAD
5. MS Word
6. Excel

The software shall be of original version with licenses and be made available for the Engineer's use.

The Contractor shall consult the Engineer and seek approval for the usage of any other software.

G Project Meetings

Hold regular project meetings as necessary for the proper management and coordination of the Contract and as required by the Employer and Engineer. Meetings will be held on site in intervals agreed with the Employer and the Engineer.

Attend all meetings and inform sub-contractors and suppliers when their presence is required.

The chair shall be taken by the Engineer.

Minutes shall be taken and distributed by the Engineer. Three copies will be furnished to the Contractor.

Persons designated by the Contractor to attend and participate in the Project Meetings shall have all required authority to commit the Contractor to solutions agreed upon in the Project Meetings.

MANAGEMENT AND ADMINISTRATION PROCEDURES (01100) (CONT'D)

G Project Meetings (Cont'd)

The Project Meetings are classified as:

Pre-construction Meeting, Progress of the Work Meeting, Coordination of the Portions of the Work Meeting and Special Project Meeting each as defined hereunder:

H Pre-Construction Meetings

Pre-construction meetings will be scheduled within seven (7) days prior to commencement of the Work. Provide attendance by authorised representatives of the Contractors and all major sub-parties and request their attendance.

I Agenda

1. Organisational arrangements of Contractor's forces and personnel.
2. Channels and procedures for communication.
3. Construction Schedule, including sequence of critical Work.
4. Contract Documents, including distribution of required copies of original documents.
5. Processing of data submitted to the Engineer for review.
6. Processing of Site (Field) decisions and Variation Orders.
7. Rules and Regulations governing performance of Work.
8. Procedures for safety and First Aid, Security, Quality Control, Housekeeping and other related matters.

J Progress of the Work Meeting

Progress of the Work Meeting will be scheduled at maximum intervals of once per month and may be fortnightly or weekly as the Engineer deems necessary. Provide attendance by authorised representatives of the Contractor and all major sub-contractors other than those who are permanently on site. The Engineer will advise other interested parties and the Contractor will request their attendance.

MANAGEMENT AND ADMINISTRATION PROCEDURES (01100) (CONT'D)**K Coordination Meeting**

Coordination Meeting will be scheduled at intervals approved by the Engineer so as to cope with the progress of the Work and the Contractor's submittals. Provide attendance by authorised representatives of the Contractor and all major sub-contractors. The Engineer will advise other interested parties and request their attendance.

L Special Project Meeting

Special Project Meeting will be scheduled on request of the Employer, the Engineer and/or the Contractor for any special site matter. Agenda items should be distributed at least 24 hours in advance of the Special Project Meeting.

M Sub-contractors' Site Meetings

The Contractor shall hold meetings with appropriate sub-contractors and suppliers shortly before main site meetings to facilitate accurate reporting of progress.

N Notice of Completion

The Contractor shall give the Engineer at least two weeks notice of the anticipated date of final completion of the whole or part of the Work.

O Labour Record

Each week, the Contractor shall provide for verification by the Engineer a record showing the number and description of craftsmen, labourers and other persons employed on or in connection with the Work on each day of that week.

P Plant Record

Each week, the Contractor shall provide for verification by the Engineer a record showing the number, type and capacity of all mechanical and power operated plant employed on the Work on each day of that week.

Q Materials Record

Each week, the Contractor shall provide for verification by the Engineer a record showing the quantity and type of materials delivered to the site on each day of that week

MANAGEMENT AND ADMINISTRATION PROCEDURES (01100) (CONT'D)

R Visitors Record

The Contractor shall maintain a record of visitors to the site and submit at monthly intervals to the Engineer

S Weather Records

The Contractor shall keep an accurate record of:

1. daily maximum and minimum air temperature (including overnight),
2. number of hours per day in which Work is prevented by inclement weather and provide at least four maximum and minimum thermometers at agreed locations inside the building.

T Supervisory Staff

The minimum qualifications of supervisory site staff shall be as specified. Give maximum possible notice to the Engineer before changing any supervisory staff.

The Contractor's and sub-contractor's senior site staff shall be fluent in technical English. An adequate number of personnel shall have sound technical backgrounds and be fluent in both Arabic and English.

U Inspection

The Contractor shall give not less than one working day's notice (48 hours for wet trades) to the Engineer before covering up any work that is to be put out of view so that such work may be inspected by the Engineer.

V Overtime Working

Whenever overtime is to be worked, the Contractor shall give the Engineer not less than 48 hours notice, specifying times, types and locations of Work to be done.

Work concealed during overtime for which notice of covering up has not been given may be required to be opened up for inspection and reinstated at the Contractor's expense.

SUBMITTALS (01300)

A. **Scope**

This Section generally specifies procedures regarding submittals and the required submittals for the Contract. However, additional procedures and requirements for submittals are specified in individual Sections of the specifications.

Submittals shall include but not be limited to the following:

1. Product Data.
2. Construction Program.
3. Shop Drawings and Samples.
4. Certificates.
5. Test and Inspection Reports.
6. Miscellaneous Submittals.
7. Site Layout Organizational Chart.
8. Progress Reports.
9. Correspondence.
10. CAD Produced Drawings.
11. Photographs of Construction Progress.

THE REQUIREMENTS OF THIS SECTION DO NOT SUPERSEDE OR TAKE PRECEDENCE OVER ANY PROVISION OF THE CONDITIONS OF CONTRACT. SHOULD ANY DISCREPANCY BECOME APPARENT BETWEEN THESE REQUIREMENTS AND THE CONDITIONS OF CONTRACT, THE REQUIREMENTS OF THE CONDITIONS OF CONTRACT SHALL PREVAIL.

SUBMITTALS (01300) (CONT'D)**B. Definitions**

The work related submittals of this Section, in addition to the definitions of the Conditions of Contract and elsewhere in the Contract Documents, are further categorized for convenience as follows:

1. Product data shall include manufacturer's latest standard printed literature such as manufacturer's installation instructions, catalog cuts, colour charts, roughing diagrams, wiring diagrams, and performance curves on materials, equipment and systems for this project. Product data shall include references to applicable Specification Section and item number. Product data shall be in addition to the required shop drawing submittals.
2. Construction Program shall be in the form of Computerized Network Precedence Diagrams incorporating activities for all work to be performed by the Contractor, his sub-contractors and other sub-contractors to be employed in or about the Site, supported by computer analysis and schedules and prepared in accordance with the principles of Critical Path Method Programming.
3. Shop drawings shall include specially prepared technical data with diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, plans, Sections, details and measurements in standard printed form (A4 size or A0 size for drawings). Shop drawings shall be in addition to the required product data and shall indicate applicable specification Section and item numbers.
4. Samples shall include physical examples of materials, both fabricated and unfabricated, in complete units and as smaller portions of units, for visual inspection and where indicated, for more detailed testing and analysis. Samples shall indicate applicable specification Section and item numbers within that Section.
5. Certificates shall include statements of suitability, certifying reports from governing agencies, industry standards and testing agencies and applicable certificates specified in each Section of the specification.
6. Test and Inspection reports shall include reports specified to be required in each Section of the specifications.
7. Schedules shall include schedule of required submittals organized by related specification Section number and sequence of submission, schedule of sequence of work and time schedule, schedule of sequence of application of specific units of work and schedule of materials, equipment and systems as listed in applicable Sections of the specification.

SUBMITTALS (01300) (CONT'D)

B. Definitions

8. Miscellaneous submittals shall include submittals related directly to the work (non-administrative) include warranties, maintenance agreements, workmanship bonds, survey data and reports, physical work records, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work and not processed as shop drawings, product data, samples or certificates.

C. Submittal Procedures

1. Submittal Schedule

- a. Schedule submissions to ensure that the Engineer is allowed a reasonable time to review each submission within the scheduled period of time.
- b. Certify that each submittal has been checked and approved by Sub-contractors, installers, manufacturers and suppliers. Note any deviations from drawings or specifications.
- c. No submissions shall be processed without signed and approved certification of the Contractor. This certification shall be indicated on each submission as follows:

"Material submitted for approval has been checked for conformance with drawings and specifications for this project. Any deviations from plans and specifications have been noted on the material or listed in the transmittal letter.

Signed

(Contractor)

2. Coordination and Sequencing

- a. Coordinate preparation and processing of submittals with the Construction Program and progress so that the work will not be delayed.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

2. Coordination and Sequencing (Cont'd)

- b. Coordinate and sequence submittals for work and work interfaced with other work so that the processing of submittals will not be delayed by the lack of required coordination between submittals.
- c. The obligation to coordinate the work indicated on any submittal material with other trades and with field conditions is the responsibility of the Contractor. No claim will be allowed for work that may have to be moved or replaced based on a claim that the work was placed in accordance with dimensions indicated on an approved submittal.
- d. No claim for an extension of Contract Time will be granted because of Contractor's failure to coordinate submissions.

3. Submittal Preparation and Procedure

- a. Contractor shall submit shop drawings and samples accompanied by "Shop Drawing and Samples Transmittal" forms.
- b. The format of transmittal forms shall be to the approval of the Engineer.
- c. Typed transmittal forms should indicate the following:
 - 1. Contract No.: Contractor's name and job number.
 - 2. Specification Section: The specification Section number of item specified. (Do not submit items from more than one specification on the same form).
 - 3. Submitted By: Name of Contractor's employee responsible for Contractor's review.
 - 4. Contract Works Title: Name of Contract.
 - 5. Transmittal No.: Transmittal numbers shall be consecutive for the Works.
 - 6. Date Submitted: Date on which shop drawings and sample leave Contractor's office.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

3. **Submittal Preparation and Procedure (Cont'd)**

c. Typed transmittal forms should indicate the following: (Cont'd)

7. Contractor: Name of firm preparing (and/or Supplier) original documents (Shop Drawings or Samples).
8. Submission No.: 1st, 2nd, 3rd. etc., depending on previous submission for same items (see resubmittal procedure).
9. Specification Section Paragraph: Specific paragraph under which item is specified.
10. Copies and Type: Number of copies submitted and type of material submitted (electronic, print, brochure or sample, etc.).
11. Drawing No./Description and Date: Number of the Drawing. Title on the submission (where possible) and date on the submission. Where a group of related drawings are submitted as one unit, only one entry need to be made with a general description of what is included. (Drawings should then be numbered consecutively and have the same date).
12. Contractor's Remarks: Clearly note any exceptions or deviations from the Contract Documents and state reasons for them.

d. **Resubmission**

Resubmittal procedures shall follow the same procedures as the initial submittal with the following exceptions:

1. Transmittal shall contain the same information as the first transmittal except that transmittal numbers shall run consecutively and the submission number shall indicate 2nd, 3rd, etc. submission. The drawing number/description shall be identical to the initial submission and the date shall be the revised date for that submission.
2. No new material shall be included on the same transmittal for a resubmission.

SUBMITTALS (01300) (CONT'D)**C. Submittal Procedures (Cont'd)****3. Submittal Preparation and Procedure (Cont'd)****e. Engineer's and Engineer's Representative's Action on Transmittal Form**

Incomplete or erroneous transmittals will be returned with directives indicated.

f. Submittal Procedures by Contractor

1. All correspondence to the Engineer and attachments thereto shall be submitted in one original and four copies and one digital copy.

2. Four prints and one digital of each shop drawing with transmittal forms shall be submitted to the Engineer's Representative. Three more prints shall be submitted by the Contractor after actioning.

3. Two samples of each material or prefabricated component with transmittal forms to the Engineer.

4. Four copies of brochures, one of which must be an original, with transmittal forms to the Engineer.

4. Product Data

a. Submit product data as called for under "Submittals" in each individual Specification Section.

b. Submit product data in triplicate for review. Indicate the actual materials being submitted for review when literature contains selections.

5. Construction Program

The Contractor shall prepare a Construction Program showing the order and method in which he proposes to execute the works and the dates upon which the various elements, trades and Sections of the works will be started and completed, including dates for submittal and approval of shop drawings and samples; for procurement and delivery of materials and equipment; for construction, installation, inspection, testing and commissioning.

SUBMITTALS (01300) (CONT'D)**C. Submittal Procedures (Cont'd)****5. Construction Program (Cont'd)**

- a. The Construction Program shall be in the form of Computerized Network Precedence Diagrams incorporating activities for all work to be performed by the Contractor, his sub-contractors and other contractors to be employed in or about the site, supported by computer analysis and schedules and prepared in accordance with the principles of Critical Path Method (CPM) programming.
- b. The Construction Program shall be prepared by a qualified Network Analysis Consultant in collaboration with the Contractor. The Network Analysis Consultant shall be approved by the Engineer and shall be skilled and experienced in construction programming of the kind specified for this project. The Network Analysis Consultant shall provide the Engineer access to his database for loading into the Engineer's computer system, whether by means of floppy diskettes or dataline communications.
- c. The network diagrams shall be clearly and accurately presented with work activities relating to specific locations or levels grouped for ease of reference. Each work activity shall have the following information shown in the diagram:
 1. Activity number.
 2. Concise description of the work.
 3. Specification reference or trade code.
 4. Location of work or area code.
 5. Duration in calendar days.
- d. Computer Analysis
 1. In addition to the network diagrams the Contractor shall submit the following computer analysis output:
 - a. Activity Status Report.
 - b. Master Working Report: chronological listing by early start of all activities and milestones.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

5. Construction Program (Cont'd)

d. Computer Analysis (Cont'd)

1. In addition to the network diagrams the Contractor shall submit the following computer analysis output: (Cont'd)

c. Milestone Report: Chronological listing by early start of all milestones.

d. Contractor Reports; individual reports, sorted chronologically by early start, for each Sub-Contractor. These reports will only have the early start and early finish dates for distribution to Sub-contractors.

e. Material Procurement Report: based on the early start Construction Program, for all material items. This report shall include dates for submittal, approval release for ordering/fabrication, shipping and delivery to site.

f. Shop Drawings and Samples Reports: This schedule shall detail the dates for submission and approval of shop drawings and samples required by the Contract Documents, including those required from Sub-contractors, and shall make due allowance for reasonable time of processing of shop drawings by the Engineer.

g. Manpower Report: a listing of all activities displaying estimated crew sizes and manpower requirements for each activity.

h. Current Status Report: a listing of actual start and finish dates, activities already started and completed and percentage completion of activities still in progress.

j. Cash Flow Report: showing projected monthly and cumulative expenditure.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

5. **Construction Program (Cont'd)**

d. **Computer Analysis (Cont'd)**

2. The activity status report shall have the following minimum data for each activity:
 - a. Activity number.
 - b. Concise description of the work.
 - c. Specification reference or trade code.
 - d. Location of work or area code.
 - e. Duration in calendar days.
 - f. Early start date (calendar).
 - g. Early finish date (calendar).
 - h. Late start date (calendar).
 - j. Late finish date (calendar).
 - k. Total float (calendar days).
 - l. Estimate crew size.
 - m. Percentage completion.
 - n. Remaining duration in calendar days.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

5. Construction Program (Cont'd)

e. Supporting Data

1. The Contractor shall also prepare and submit in narrative form the supporting data noted below with the submittal of his Construction Program. Any changes in this information shall be submitted with successive updates and revision.
 - a. The proposed number of working days per week.
 - b. The holidays, and other non-working days (except Sundays) observed during the duration of the Contract (by date).
 - c. The planned number of shifts per day.
 - d. The number of hours per shift.
 - e. The planned usage of major construction plant and equipment on the site, on a monthly basis.
 - f. The planned procurement and delivery of local and imported materials.
 - g. The average weekly manpower usage for each trade to be employed for the works.
 - h. The productivity rates for each major work sequence or for any specific activities required by the Engineer.
 - j. Explanation of all changes in logic, durations, manpower, plant and equipment.
 - k. Actual start and finish dates of activities already completed, and percentage completion of activities still in progress.

SUBMITTALS (01300) (CONT'D)**C. Submittal Procedures (Cont'd)****5. Construction Program (Cont'd)****f. Forty five (45) Day Program**

At monthly intervals, the Contractor shall submit a separate program developed from the approved Construction Program covering a period of forty five calendar days and denoting the Contractor's and Sub-Contractor's daily work activities and their interrelationship with the work of other Contractors, if any.

g. Construction Program Revisions and Updates

1. Once the initial Construction Program is submitted and approved by the Engineer, the Network Analysis Consultant shall perform monthly updates in collaboration with the Contractor. The update will follow a visit to the job site where in the presence of the Engineer, the Network Analysis Consultant and the Contractor will record the actual starts and percentages complete and, using this data, update the computer analysis. The updated analysis will be accompanied by a narrative report containing the supporting data referred to herein before, which shall indicate the necessary action dates and requirements for material, labour and plant acquisition. The narrative report shall also focus upon the construction progress and shall particularly note conditions that may delay progress of the work. In the event of such delays, the Contractor shall describe actions proposed to overcome the delay and to maintain the planned construction program.

2. Site progress meetings attended by the Engineer, the Contractor, the Network Analysis Consultant and the principal Sub-contractors, will be held monthly, immediately following the monthly site visit referred to in the previous paragraph, specifically to review the progress of the work. At this meeting the latest update of the last approved Construction Program will be examined with reference to the records made during the said site visit in order to verify the following:

a. Actual start and finish dates of activities completed during the period since the previous update or revision.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

5. **Construction Program (Cont'd)**

g. **Construction Program Revisions and Updates (Cont'd)**

2. (Cont'd)

- b. Remaining durations and percentage of completion for all activities in progress.
 - c. Logic, time and cost data for variation order work that will be incorporated into the Construction Program.
 - d. Contractor's measures to rectify delays from the planned dates.
3. The Contractor shall perform the work in accordance with the latest approved Construction Program. If any work is found not to be on program during any regular review of the work, the Contractor shall immediately advise the Engineer in writing of action proposed to bring the work back on program. The Contractor shall thereupon prepare and submit a revised Construction Program indicating such action, together with a list of revisions to program logic. Correction and updating of the program will be done as often as necessary until the project is back on program.
4. Within five (5) working days after receipt of a notice from the Engineer, the Contractor shall submit a revised Construction Program for any of the following reasons:
- a. When delays in completion of any activity or group of activities indicates a slippage of the Contract completion date or a milestone date by fourteen (14) calendar days or ten percent (10%) of the remaining duration of the Contract period, whichever is less.
 - b. When delays in submittals or deliveries or work stoppage are encountered which make replanning of the work necessary.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

5. **Construction Program (Cont'd)**

g. **Construction Program Revisions and Updates (Cont'd)**

4. (Cont'd)

- c. When the program does not represent the actual execution and progress of the work being performed in the field.
 - d. Where a change in the work sequence is proposed or has been instituted by the Contractor. Any such change should not, in any case, be made without the Engineer's approval.
 - e. Where the issue of a variation or change order or other instruction would significantly affect the program and/or progress of the works.
5. In the event the Contractor requests an extension of time for completion of the works or requests an extension to the specified milestone dates, he shall furnish such justification and supporting data as the Engineer may deem necessary for the evaluation thereof. Submission of proper substantiation based on revised activity logic, durations and costs is obligatory with any such request.
6. Float belongs to the project and must be used in the best interest of completing the project on time. Accordingly, any existing float shall be used to the maximum extent possible to offset unexpected delays which occur in connection with the Contractor's work, acts of God (Force Majeur), and authorized variations in the scope of the work.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

5. **Construction Program (Cont'd)**

h. **Program Submittal Procedures and Requirements**

1. Submittal of the initial Construction Program for approval shall be in accordance with the following procedure:
 - a. The Contractor shall submit his initial Construction Program, in four copies and one digital, within 3 weeks of the date of signing of the Contract. Such initial Construction Program shall include the following completed documents:
 - * Network Precedence Diagram showing the sequence and interdependence of all items of work required under the Contract and milestone dates.
 - * All the computer analysis report required under this Contract.
2. After approval of the Contractor's initial Construction Program, all subsequent revision and monthly update submittals shall comprise the following:
 - a. Four (4) prints of the Network Diagrams from the last approved Construction Program, suitably marked up in red ink to show all revisions, and signed by the Contractor and all Sub-contractors.
 - b. Four (4) copies of the updated Activity Status Report.
 - c. Four (4) copies of all supporting data.
 - d. Four (4) copies of the updated master working report.
3. Revisions and monthly updates to the Construction Program shall be submitted within five (5) working days of the data date for inputting revised/updated information to create the revision/updated computer analysis. The data date for the first monthly update shall be one month after approval by the Engineer of the Contractor's initial Construction Program, and successive data dates shall be at monthly intervals. The said data date should coincide with the date of the site progress meeting at which time the records of progress are verified.

SUBMITTALS (01300) (CONT'D)**C. Submittal Procedures (Cont'd)****5. Construction Program (Cont'd)****h. Program Submittal Procedures and Requirements (Cont'd)**

4. Each program submitted shall be signed by all principal Sub-contractors (including nominated sub-contractors) before being submitted to the Engineer thereby confirming that they have reviewed the said program. If any Sub-Contractor has reservations regarding his ability to comply with the requirements of the program to which he has appended his signature, the Contractor shall instruct the Sub-Contractor to list such reservations in writing and a copy thereof shall be submitted to the Engineer with the program submittal for his information. No reservation by any Sub-Contractor, nor the fact of informing the Engineer in respect thereof, shall relieve the Contractor of his responsibilities under the Contract in the time prescribed therein.
5. Submit a bi-weekly report detailing the preparation, submittal and approval status of shop drawings, materials and equipment, samples and mock-ups and the status of materials and equipment procurement, order placed, delivery periods and site delivery dates.

j. Programming Costs

All costs in establishing, maintaining, revising and updating the construction program shall be borne by the Contractor.

6. Shop Drawings and Samples

Shop drawings shall establish actual details of manufactured or fabricated items and of work to be executed; they shall clearly identify materials, dimensions, thicknesses, components, attachments, relation with adjoining work and spaces, and all other pertinent information. Shop drawings shall clarify and amplify the design drawings and other design requirements and shall, subject to the Engineer's approval, incorporate minor changes in design or construction as may be necessary or otherwise desirable to suit the requirements of the work. Where the Contract Documents require the Contractor to submit samples, the same shall satisfactorily establish that the quality, construction, workmanship, finish, colour, pattern and any other characteristics of the material or equipment to be provided, are in conformance with the Contract requirements and to the Engineer's reasonable satisfaction.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

6. Shop Drawings and Samples (Cont'd)

- a. The Contractor shall prepare, review, coordinate and submit to the Engineer for his approval such shop drawings and samples as are required by the Contract Documents or as may be required by the Engineer during the course of the works.
- b. At the time of making his submission, the Contractor shall inform the Engineer in writing of any deviation between shop drawings/samples being submitted and the requirements stipulated or reasonably implied by the Contract Documents.
- c. By submitting shop drawings and samples the Contractor thereby represents that he has determined and verified all dimensions, relation to existing work, coordination with work to be installed later, coordination with information in previously submitted shop drawings and has verified their compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor and in reviewing shop drawings and samples the Engineer shall be entitled to rely upon the Contractor's representation that such information is correct and accurate. The Contractor shall be responsible for and shall make any alterations in the work due to discrepancies, errors or omissions in the shop drawings and samples supplied by him whether or not such shop drawings and samples have been approved by the Engineer, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor by the Engineer. The Contractor shall be responsible for the correct locations of his work, irrespective of approval by the Engineer, and shall pay all costs and expenses incurred by others due to improper location of his work.
- d. Sub-contractors shall submit their shop drawings and samples through the Contractor who shall review and coordinate with his own and other Sub-Contractor's drawings and/or samples before submitting to the Engineer. The Contractor shall be responsible in all respects for his sub-contractor's shop drawings and samples as if they were his own.

SUBMITTALS (01300) (CONT'D)**C. Submittal Procedures (Cont'd)****6. Shop Drawings and Samples (Cont'd)**

- e. Neither the fabrication of prefabricated items, nor the ordering of any work, materials or equipment, nor the execution of any work on site, shall commence until shop drawings and samples, relevant to the said items, work, etc., and required by the specifications, have been submitted and approved in writing by the Engineer.
- f. Shop drawings to be prepared by the Contractor and by his principal Sub-contractors for structural, architectural and electro-mechanical works, shall be prepared on or in the neighborhood of the site to facilitate proper liaison and coordination between trades and so as to allow the Engineer ready access for review and approval during the preparation process.
- g. Shop drawings and samples shall be prepared after site dimensions have, if possible, been taken. Shop drawings shall be prepared on reproducible transparencies, and using metric units of measurement.
- h. Shop drawings shall describe accurately the method of fabrication; installation, applied finishes, types and sizes of all members and fixings, and shall, where applicable, indicate methods of marking components for site erection. Shop drawings shall be to scales approved by the Engineer.
- j. The Contractor shall verify all dimensions and field conditions and shall check and coordinate the shop drawings and samples required in connection with a particular trade or Section of the works with the requirements of other trades or Section related thereto.
- k. In order to ensure proper coordination, shop drawings and samples for each system or element of work shall be submitted in a single package. The Engineer may require in writing that all relevant parts of a system or element be submitted before any component item is approved.
- l. Except for finish, pattern, colour and other matters in respect of which the Engineer's decision is required in accordance with the Contract Documents, the Engineer's review and approval of shop drawings and samples submitted by the Contractor is for general conformance with the design concept and specifications and shall not relieve the Contractor from responsibility for any deviation from, or errors or omissions in respect of the requirements of the Contract Documents, unless the Contractor has informed the Engineer in writing of specific deviations and the Engineer has given written approval thereto.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

6. Shop Drawings and Samples (Cont'd)

- m. The Contractor shall make any corrections or amendments required by the Engineer's review of shop drawings and samples and shall resubmit until the "APPROVED" status is achieved. All such corrections or amendments shall be clearly indicated on the resubmitted drawings by the use of revision numbers in circles or triangles, or other method approved by the Engineer.
- n. The Contractor shall direct specific attention in writing on resubmitted shop drawings and samples to revisions other than the corrections requested by the Engineer or previous submissions. Unless such written notice has been given, approval of a resubmitted shop drawing or sample shall not constitute approval of any changes not requested on the prior submission.
- p. In the event of written rejection by the Engineer to a particular sample of material, the Contractor shall submit within fourteen (14) calendar days of such rejection, samples of three alternative materials for the Engineer's approval and the Engineer shall reject or approve all or any of these materials within fourteen (14) days of their submission. This procedure shall be repeated until such time as a sample of material is approved by the Engineer. Failure on the part of the Contractor to obtain the Engineer's approval, which shall not be withheld unreasonably, to all or any one sample or material shall in no way relieve the Contractor of his liabilities and obligations under the Contract.
- q. The Engineer may at any time call upon the Contractor to submit samples of any material used or to be used in the work, including those specified in the Contract by "Brand Name", for comparison with the specification and/or approved sample. Should any such sample fail to meet the requirements of the specification and/or standard of the accepted sample, then all materials from which the sample has been taken shall be removed from the site immediately and all work executed incorporating such material shall be removed and made good to the satisfaction of the Engineer all at the expense of the Contractor.

SUBMITTALS (01300) (CONT'D)

C. **Submittal Procedures (Cont'd)**

6. **Shop Drawings and Samples (Cont'd)**

- r. No acceptance or approval by the Engineer of any shop drawing or sample submission made by the Contractor, nor any notes, comments, stipulations, requests for clarifications, etc., made by the Engineer upon such submissions during his review and approval thereof, shall constitute an authorization to any variation in the Contract price or to any extra time for completion of the works.

7. **Certificates**

- a. Submit certificates as called for under "Submittals" in each individual specification Section.
- b. Submit certificates in triplicate for review.

8. **Test and Inspection Reports**

Submit test and inspection reports as called for in each individual Specification Section.

9. **Miscellaneous Submittals**

Refer to each individual Specification Section and the Contract Documents for additional submittal requirements.

10. **Site Layout Organization Chart**

- a. The Contractor shall prepare and submit to the Engineer's Representative for his approval, a Site Layout Organization Plan and any modifications thereafter showing the Contractor's proposed layout of his facilities on site taking into consideration the site offices to remain until substantial completion. The layout of facilities shall provide full details for the following:

1. **Temporary Facilities**

- a. Contractor's and Sub-Contractor's site office accommodations.
- b. Temporary storage.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

10. Site Layout Organization Chart

a. (Cont'd)

1. Temporary Facilities (Cont'd)

- c. Workshop for formwork, reinforcement and electro-mechanical works.
- d. Guard house.
- e. Engineer offices (6 offices and meeting room completely fitted as directed with Engineer including Secretary and office boy, offices shall be fitted with 5 PC computers, AutoCAD Programme, Network and e-mail with Primavera and Microsoft office, A2 and A3 colored printers and Photocopy with all related supplies and maintenance)
- f. Temporary sanitary accommodation
- g. Fences and gates

2. Plant

- a. Mobile and Tower Cranes.
- b. Generator
- c. Water tank
- d. Storage areas.
- e. Repair shops

3. Safety

Temporary fire-fighting facilities for all offices, workshops and storage areas including all other construction safety requirements as directed by the Engineer and Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction.

11. Progress Reports

The Contractor shall submit to the Engineer each week a progress report showing actual progress by identifying activities and Works commenced and those completed during the previous week, estimated time required to complete all activities under way in relation to the programme of Works, a detailed programme for activities to be carried out during the following week and progress photographs. Such reports shall be to the satisfaction of the Engineer.

SUBMITTALS (01300) (CONT'D)

C. Submittal Procedures (Cont'd)

12. Submittal of Correspondence

Except where more are required by the contract, all correspondence to the Engineer shall be submitted as follows:

- a. One original and two photocopies of transmittals and letters including attachments/enclosures.

13. CAD Produced Drawings

- a. The Contractor shall prepare his shop drawings, progress record drawings, and final as-built drawings using computer aided design and drafting techniques (CAD).
- b. All computer hardware, software and computer room necessary for the preparation of drawings using CAD shall be provided by the Contractor at no additional cost.

14. Photographs of Construction Progress

- a. During the progress of the work, submit one digital and in triplicate, coloured photographs taken once a month by an approved professional photographer consisting of minimum ten (10) views, all taken where directed by the Engineer. The prints shall be 130 x 180mm matt finish.
- b. At the completion of all work final photographs shall be taken as directed by the Engineer.
- c. All digital files and negatives shall be retained by the photographer until completion of the work at which time they shall be delivered to the Employer in their proper order and shall become the property of the Employer.
- d. The Contractor shall submit photographs for all works to be covered before covering such works to the approval of the Engineer.

SUBMITTALS (01300) (CONT'D)

D. Engineer's Representative Review of Submittals

1. The Engineer's Representative will process the submission and indicate the appropriate action on the submission and the transmittal.
2. The Engineer's Representative will process transmittals in the following sequence:
 - a. Date Received
Date arriving in the Engineer's Representative office.
 - b. Date Return
Date leaving the Engineer's Representative office to the Contractor.
 - c. To/Date
Name of Engineer to whom submission is sent for review and date leaving the Engineer's Representative office.
 - d. From/Date
Name of Engineer reviewing submission and date arriving in the Engineer's Representative office.
 - e. Action
Indicate action taken on submission.
 - f. Distribution
Number of copies distributed and type of material distributed (electronic, print, brochure or sample, etc.).
 - g. Engineer's and Engineer's Representative Remarks
Note major deviations from the Engineer's Contract Documents or reasons for resubmit if there are not notes on the material submitted.

QUALITY REQUIREMENTS (01400)

A. **Scope**

1. Section Includes
 - a. Quality control and control of installation.
 - b. Tolerances
 - c. References.
 - d. Mock-up requirements.
 - e. Testing and inspection services.
 - f. Manufacturers' field services.
 - g. Examination.
 - h. Preparation.

B. **Quality Control And Control Of Installation**

1. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
2. Comply with manufacturers' instructions, including each step in sequence.
3. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
4. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
5. Perform Work by persons qualified to produce required and specified quality.
6. Verify that field measurements are as indicated on Shop Drawings or as instructed by the manufacturer.
7. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

QUALITY REQUIREMENTS (01400) (CONT'D)

C Tolerances

1. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
2. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
3. Adjust products to appropriate dimensions; position before securing products in place.

D References

1. For products or workmanship specified by association, trade or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
3. Obtain copies of standards where required by product Specification Sections.
4. Should specified reference standards conflict with Contract Documents, request clarification from the Engineer before proceeding.
5. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

E Mock-Up Requirements

1. Tests will be performed under provisions identified in this Section and identified in the respective product Specification Sections.
2. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
3. Accepted mock-ups shall be a comparison standard for the remaining Work.
4. Where mock-up has been accepted by Engineer and is specified in product Specification Sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

QUALITY REQUIREMENTS (01400) (CONT'D)

F Testing And Inspection Services

1. Scope

This Section covers testing services including selection and payment, contractor submittals, agency responsibilities, agency reports, limits on testing authority, contractor responsibilities and schedule of tests.

Employment and payment for services of an independent testing agency or laboratory to perform specified testing, shall be borne by Contractor

Employment of testing agency or laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

2. Performance and Standards

ASTM C802 - Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction.

ASTM C1021 - Practice for Laboratories Engaged in the Testing of Building Sealants.

ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

ASTM C1093 - Practice for Accreditation of Testing Agencies for Unit Masonry.

ASTM E329 - Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction.

ASTM E543 - Practice for Determining the Qualification of Nondestructive Testing Agencies.

ASTM E548 - Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies.

ASTM E699 - Practice for Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E6.

QUALITY REQUIREMENTS (01400) (CONT'D)

F Testing And Inspection Services (Cont'd)

3. Submittals

- a. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time specialist and responsible officer.
- b. Submit copy of report of laboratory facilities inspection made, with memorandum of remedies of any deficiencies reported by the inspection.

4. Agency Responsibilities

- a. Test samples of mixes submitted by Contractor.
- b. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
- c. Perform specified sampling and testing of Products in accordance with specified standards.
- d. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- e. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
- f. Perform additional tests required by Engineer.
- g. Attend preconstruction meetings and progress meetings.

QUALITY REQUIREMENTS (01400) (CONT'D)

F Testing And Inspection Services (Cont'd)

5. Agency Reports

- a. After each test, promptly submit four copies of report to Engineer and to Contractor.
- b. Include:
 - i. Date issued.
 - ii. Project title and number.
 - iii. Name of inspector.
 - iv. Date and time of sampling or inspection.
 - v. Identification of product and Specifications Section.
 - vi. Location in the Project.
 - vii. Type of inspection or test.
 - viii. Date of test.
 - ix. Results of tests.
 - x. Conformance with Contract Documents.
- c. When requested by Engineer, provide interpretation of test results.

6. Limits on Testing Authority

- a. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- b. Agency or laboratory may not approve or accept any portion of the Work.
- c. Agency or laboratory may not assume any duties of Contractor.
- d. Agency or laboratory has no authority to stop the Work.

7. Contractor Responsibilities

- a. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
- b. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.

QUALITY REQUIREMENTS (01400) (CONT'D)

F Testing And Inspection Services (Cont'd)

7. Contractor Responsibilities (Cont'd)

- c. Provide incidental labor and facilities:
 - i. To provide access to Work to be tested.
 - ii. To obtain and handle samples at the site or at source of Products to be tested.
 - iii. To facilitate tests.
 - iv. To provide storage and curing of test samples.
- d. Notify Engineer and laboratory 36 hours prior to expected time for operations requiring testing services.

8. Schedule of Tests

Individual Specification Sections: Tests required and standards for testing.

G Manufacturers' Field Services

- 1. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test and adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- 2. The Contractor shall submit qualifications of observer to Engineer 30 days in advance of required observations. The observer shall be subject to the approval of Engineer.
- 3. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

H. Examination

- 1. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- 2. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- 3. Examine and verify specific conditions described in individual Specification Sections.
- 4. Verify that utility services are available, of the correct characteristics, and in the correct locations.

QUALITY REQUIREMENTS (01400) (CONT'D)

J. **Preparation**

1. Clean substrate surfaces prior to applying next material or substance.
2. Seal cracks or openings of substrate prior to applying next material or substance.
3. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500)

A. **Scope**

The scope of this Section covers:

1. Temporary Utilities: electricity, lighting for construction purposes, site lighting, ventilation, telephone service, facsimile service, water service and sanitary facilities.
2. Temporary Controls: barriers, exterior enclosures, fences and gates, security, traffic safety, pollution control and first aid facilities.
3. Construction Facilities: parking, progress cleaning and waste removal, project identification, field offices and sheds, planted small tools, scaffolding and hoisting.
4. Removal of utilities, facilities and controls.

B. **Performance and Standards**

1. Comply with applicable codes and regulations of Authorities having jurisdiction, and to the direction of the Engineer.
2. Take all precautions necessary to protect persons and property on or off site from injury or damage resulting from work under this contract.

C. **Related Items**

01015 Contractor's use of Site
01050 Field Engineering
01700 Execution Requirements: Cleaning

D. **Electricity**

1. Provide, maintain and pay for power service required for the works from time of project mobilization until handing over.
2. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required.
3. Provide main service disconnect and over-current protection at convenient location.
4. Permanent convenience receptacles may not be utilized during construction.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)

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

5. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.
 - a. Provide 20 ampere duplex outlets, single phase circuits for power tools for every active work area.
 - b. Provide 20 ampere, single phase branch circuits for lighting.

E. **Lighting for Construction Purposes**

1. Provide and maintain incandescent lighting for construction operations to achieve acceptable lighting level.
2. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes.
3. Provide and maintain H.I.D. lighting to interior work areas after dark for security purposes.
4. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
5. Maintain lighting and provide routine repairs.
6. Permanent building lighting may not be utilized during construction.

F. **Site Lighting**

The Contractor shall install temporary site lighting including but not restricted to perimeter fence, name boards, parking areas and for site safety to the satisfaction of the Engineer and according to Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction.

G. **Ventilation**

1. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)

H. **Telephone Service**

1. Provide, maintain, and pay for telephone service to field office and Engineer field office from time of project mobilization until completion of the works.

J. **Facsimile Service**

1. Provide, maintain and pay for facsimile services and a dedicated telephone lines to field office and Engineer's field office from time of project mobilization until completion of the works.

K. **Water Service**

1. Provide, maintain and pay for suitable quality water service required for construction operations and all purposes from time of project mobilization until completion of the works.
2. Extend branch piping with outlets located so water is available by hoses with threaded connections.

L. **Sanitary Facilities**

1. Provide and maintain required facilities, enclosures, and connections. Provide from time of project mobilization until completion of the works.
2. The Contractor shall obtain all necessary approval from Local Authorities having jurisdiction before starting any sanitary connection works to the Infrastructure.

M. **Barriers**

1. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
2. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to any existing building.
3. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

N. **Exterior Enclosures**

1. Provide temporary scaffolding with geotextile screen to safeguard the public from dust and fallout as per Engineer and Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)

P. Fences and Gates

1. Temporary fence shall be provided by the Employer. The Contractor shall maintain it throughout the construction phase and shall provide any missing parts and other required deviation, extension, or additional parts. The Contractor shall be responsible for sidewalk rental if it is necessary for carrying out the works. The Contractor shall provide barriers and similar temporary construction as may be necessary for the performance of the work. Such facilities shall be substantially constructed throughout, rigidly supported and well secured.
2. Fence and gates shall be as per Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction and to match the fences in the area in all respects.
3. Provide, install and maintain electrical fixtures on the temporary fence including wires, boxes, lamps and switches as directed by the Engineer.
4. Provide and maintain construction barricades as may be required by the Engineer or ordinance, or as deemed necessary to protect the public at all times.
5. Material for the Temporary Safety fence within the site shall be at the discretion of the Contractor to safeguard the site personnel and to the approval of the Engineer.
6. All materials shall be of adequate strength and suitable for use intended, and shall be non-staining and non-corrosive.
7. Upon completion of the works, remove fences and gates and make good the area to the satisfaction of the Engineer.

Q. Security

1. Provide security and facilities to protect work, from unauthorized entry, vandalism or theft from time of project mobilization until completion of the works.
2. Employ uniformed guard service to provide watchpersons at site twenty four hours a day, seven days a week.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)**R. Traffic Safety**

1. The Contractor shall provide, erect and maintain such traffic signs, traffic control signals and such other measures as may be required by the Construction of the Works and as stated in Safety Requirements to the satisfaction of Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction and the Engineer.
2. The Contractor shall not commence any work which affects public roads until all the traffic safety measures necessitated by Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction are fully operational.
3. The Contractor shall keep clean and legible at all times all traffic signs, lamps, barriers and traffic control signals and he shall position, cover or remove them as required by the progress of the Works.
4. **Traffic Regulation**
 - a. **Flag Persons:** Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.
 - b. **Haul Routes:**
 - i. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
 - ii. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.
5. **Mud**

The wheels of all vehicles shall be well washed before being allowed to leave the Site, laydown area or any other area which the Contractor is utilizing for the purposes of this Contract. Any mud which is deposited outside the site boundary is to be removed immediately and the whole area thoroughly cleaned.

S. Pollution Control

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
2. Comply with pollution and environmental control requirements.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)

T. **First Aid Facilities**

The Contractor shall provide and maintain on site first aid facilities throughout the contract period to the approval of the Engineer.

U. **Parking**

1. Use public parking to accommodate construction personnel.
2. Do not allow vehicle parking on existing pavement.

V. **Progress Cleaning and Waste Removal**

1. Maintain areas free of waste materials, debris and rubbish. Maintain site in a clean and orderly condition.
2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
3. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
4. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.
5. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

W. **Project Identification**

1. Notice board shall be provided by the Employer. The Contractor shall maintain it. New name plates (if required) shall be fabricated and installed by the Contractor to match design.
2. The Contractor will be entitled to insert his own name. No other information may be displayed on the notice board without the express permission of the Engineer.
3. Upon completion of the Contract the Notice Board shall be removed from site and the area made good to the satisfaction of the Engineer.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)**X. Field Offices & Sheds****1. Scope**

This Section specifies the temporary field offices and sheds, services and facilities required in the construction, completion and maintenance of works.

Any proposed change in location or relocation of offices must be preceded by the submission of a drawing, indicating such change, to the Engineer for his approval.

2. Contractor's Site Offices

- a. The Contractor shall make arrangement to provide and maintain throughout the period of construction in a convenient location approved by the Engineer, adequate heated and air conditioned office accommodation for the Contractor's use and the use of his Subcontractors. Such accommodation shall include proper messing and sanitary facilities and shall be provided with suitable fire fighting facilities and adequate means of escape in case of fire, all to the approval of the Engineer as per Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction.
- b. The Contractor shall not allow any of his employees or those of his Subcontractors to maintain any temporary or permanent living quarters within the construction site.

C. Engineer's Site Office Accommodation and Equipment

1. The Contractor shall erect, provide and remove on completion offices for the Engineer comprising and not limited to the following:
 - a. Office structure of not less than 100m² comprising:
 - One office for the Project Manager.
 - Two offices for 2 No. Engineers each.
 - One conference room for 12 persons.
 - One office for secretary
 - One room for storage.
 - One room for stationary and photocopy
 - Three toilets completely fitted.
 - One kitchen fully equipped with gas range and fridge.
 - b. Furniture comprising desks, chairs, filing cabinets and open shelves, drawing racks.
 - c. Supply of adequate stationary for the Engineer's Team as required .

- d. Photocopying machine complete with automatic feeder, A3/A4 reduce/enlarge, sorter, multicopy, maintenance service, spare parts and consumable products.
- e. 2 Telephone line with 5 apparatus. All charges to be paid by the Contractor (Local calls only).
- f. 1 Telefax line and equipment in the Engineer's office. All charges to be paid by the Contractor (Local calls only).
- g. 3 No. latest PC hardware and software with 17" SVGA non-interlaced colour monitor, Mouse, Writable CDROM, Latest release of Dos, Windows, Autocad, Primavera (original copy), Access, Excel & Word Softwares 10 boxes of CDs, Plotter A2, laser printer A4, adequate UPS power supply and maintenance and e-mail connection and server.
- h. Adequate HVAC and lighting systems for each room

All fenestration shall have venetian blinds.

- 2. The Engineer's site office shall be supplied with separate external telephone lines with extension lines to all other office desk positions. Additional lines shall be provided for the facsimile machines. Each office shall be provided with two socket outlet power points and adequate fluorescent lighting in addition to openable windows with flyscreens. All charges and local telephone bills shall be paid by the Contractor.
- 3. The Engineer's site office accommodation shall be constructed of new approved material. Provide the accommodation with adequate security and fire fighting facilities and suitable means of escape in case of fire all to the satisfaction of the Engineer. Fire extinguishers and other means of fire fighting shall be regularly serviced and maintained in good working order.
- 4. Prepare and submit for approval Shop Drawings for the Engineer's site office accommodation of sufficiently large scale to indicate complete layout, furniture, equipment, services and all other items and requirements covered by this Sub-Clause. Submit brochures and catalog cuts of proposed furniture and equipment for approval.
- 5. Full time office Secretary with experience in MS word and Excel.
- 6. The Contractor shall provide daily cleaning attendance and office boy exclusively for the use of the Engineer's staff.
 - i. The Contractor shall be responsible for providing water and electricity supply for these offices throughout the construction duration until completion at no extra cost to the Employer.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)**X. Field Offices & Sheds (Cont'd)****7. Cleaning and Attendance Upon Engineer's Site Office Accommodation**

Provide daily cleaning and full time attendance of the Engineer's site office accommodation including providing one tea boy and one messenger to attend upon the requirements of the staff. The cost of cleaning materials and consumable such as, paper towels, paper tissues, toilet rolls, cookery and cutlery, tea, coffee, sugar, diskettes, CD's, toners, cartridges, stationary, etc. shall be paid for by the Contractor. The services of the tea boy and messenger, the provision of consumables and cleaning materials and the maintenance of the site office shall be extended to cover the construction duration until completion. Consumables shall be supplied and delivered to the site at regular intervals as directed by the Engineer.

8. Sheds and Storage Facilities

The Contractor shall provide on site weatherproof sheds and storage facilities for the materials intended for the Works. The Contractor shall maintain and remove the same on completion of the Works.

Y. Plant and Small Tools

The Contractor shall provide all constructional plant and small tools necessary for the proper execution of the Works.

Z. Scaffolding and Hoisting

The contractor shall provide, erect and maintain proper and adequate scaffolding, staging, stairs, ladders, chutes, materials hoist, special rigging and the like required for the Work and shall comply with all requests, safety instructions, etc, issued by the Engineer relating thereto. The Contractor shall provide all necessary guards, signals, safety devices and the like required for safety of operations including suitable runways from the hoists to each floor level and roof. These requirements include the provision of scaffolding and staging in elevator shafts for use by the elevator sub-contractor

Scaffolding shall be of tubular steel construction and designed in accordance with the requirements of BS 5973 and BS 5974.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS (01500) (CONT'D)

Z. Scaffolding and Hoisting (Cont'd)

Material hoists shall not be used for transporting personnel and only skilled personnel shall be used for the operation and maintenance of hoists. The construction, maintenance and operation of hoists shall conform to the applicable requirements of the applicable Codes in force. Use of the Permanent lift equipment for transporting materials and/or personnel will not be allowed except with prior written permission of the Engineer.

Hoists, chutes, scaffolding and the like shall be so constructed as to prevent damage, staining or marring of the Permanent Work. No materials, rubbish or debris shall be permitted to drop free, but shall be removed by use of hoists and/or fully enclosed rubbish chutes.

Where stairs, ladders, ramps, etc, are provided they shall be fitted with suitable safety railings.

On completion of the Work, the Contractor shall clear away and remove all scaffolding and hoisting.

AA. Removal of Utilities, Facilities and Controls

1. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.
2. Clean and repair damage caused by installation or use of temporary work.

PRODUCT REQUIREMENTS (01600)

A. **Scope**

1. This Section specifies the General Requirements for products, including requirements for handling, transportation and storage thereof, including adherence to the manufacturer's requirements in these respects.
2. The requirements of this Section are augmented by specific clauses specifying quality throughout all Sections of the Specification.

B. **Performance and Standards**

1. All products shall perform as specified and the handling, transportation and storage thereof shall be as specified and such that the ultimate performance of the products shall in no way be impaired.
2. The quality of products and reference to Standards and Codes of Practice is covered in Section 01060, Regulatory Requirements.
3. Where, in the course of the Project, materials, products, assemblies, equipment or techniques, are required which are not named, definitively described or implied in the Specification, they shall nonetheless conform to all relevant current Standards and Codes of Practice, and the Contractor shall maintain both as regards Materials and Workmanship and quality, suitability and performance which are not less than implicit in this Specification to the satisfaction of the Engineer.
4. The Contractor shall use his best endeavours to produce materials and work of a consistent and high quality and standard, whether or not such standard is identifiable in the Specification.
5. The Contractor shall abide by the Engineer's interpretation of the Specification and shall comply with his decisions regarding the quality of Materials and Workmanship.

C. **Related Items**

- 01060 Regulatory Requirements
- 01700 Execution Requirements - Warranties and Bonds

D. **Submittals**

Refer to Section 01300 for Submittal Procedures.

PRODUCT REQUIREMENTS (01600) (CONT'D)

E. **Product Handling**

1. **Products**

- a. Provide products of qualified manufacturers suitable for intended use. Provide products of each type by a single manufacturer unless specified otherwise.
- b. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- c. Provide interchangeable components of the same manufacturer for components being replaced.

2. **Product Delivery Requirements**

- a. Transport and handle products in accordance with manufacturer's instructions.
- b. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- c. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

3. **Product Storage And Handling Requirements**

- a. Store and protect products in accordance with manufacturers' instructions.
- b. Store with seals and labels intact and legible.
- c. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- d. For exterior storage of fabricated products, place on sloped supports above ground.
- e. Provide off-site storage and protection when site does not permit on-site storage or protection.
- f. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

PRODUCT REQUIREMENTS (01600) (CONT'D)

E. **Product Handling (Cont'd)**

3. **Product Storage And Handling Requirements (Cont'd)**

- g. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- h. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- j. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

4. **Product Options**

- a. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- b. Products Specified by Naming One or More Manufacturers: products of one of manufacturers named and meeting Specifications, no options or substitutions allowed.
- c. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

5. **Product Substitution Procedures**

- a. Engineer will consider requests for Substitutions only within 30 days after date established in Notice to Proceed.
- b. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- c. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

PRODUCT REQUIREMENTS (01600) (CONT'D)

E. **Product Handling (Cont'd)**

5. **Product Substitution Procedures (Cont'd)**

- d. A request constitutes a representation that the Contractor:
 - i. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - ii. Will provide the same warranty for the Substitution as for the specified product.
 - iii. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Employer.
 - iv. Waives claims for additional costs or time extension which may subsequently become apparent.
 - v. Will reimburse Employer and Engineer for review or redesign services associated with re-approval by authorities.
- e. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- f. Substitution Submittal Procedure:
 - i. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - ii. Submit Shop Drawings, Product Data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - iii. The Engineer will notify Contractor in writing of decision to accept or reject request.

6. **Protection**

The Contractor shall provide and maintain until practical completion all necessary protection to the installed work to prevent damage or deterioration.

EXECUTION REQUIREMENTS (01700)

A. **Scope**

The scope of this Section shall include:

1. Closeout procedures.
2. Cleaning.
3. Starting of systems.
4. Demonstration and instructions.
5. Testing, adjusting and balancing.
6. Protecting installed construction.
7. Project record documents.
8. Operation and maintenance data.
9. Manual for materials and finishes.
10. Manual for equipment and systems.
11. Instruction of Employer personnel.
12. Warranties and bonds.
13. Protection and making good.

B. **Closeout Procedures**

1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
2. Provide submittals to Engineer that are required by governing or other authorities.
3. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

EXECUTION REQUIREMENTS (01700) (CONT'D)

C. **Cleaning**

1. **General**

- a. Execute cleaning, during progress of the work, and at completion of the work.
- b. If the Contractor fails to clean up during construction or at the completion of the work, the Employer may do so and the cost thereof shall be charged to the Contractor.
- c. Conduct cleaning and disposal operations to comply with codes, ordinances and Regulations as stated in Section 01015 Part B Paragraph 1 and the Local Authorities having jurisdiction over anti-pollution laws.
- d. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- e. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

2. **Execution During Construction**

Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste material, rubbish and windblown debris, resulting from construction operations.

Provide on-site containers for the collection of waste materials, debris and rubbish.

Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3. **Dust Control**

- a. Clean interior spaces to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- b. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

4. **Final Cleaning**

- a. Employ skilled workmen for final cleaning.
- b. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.

EXECUTION REQUIREMENTS (01700) (CONT'D)

C. **Cleaning (Cont'd)**

4. **Final Cleaning (Cont'd)**

- c. Wash and shine glazing.
- d. Polish glossy surfaces to a clear shine.
- e. Vacuum clean interior of buildings including HVAC ducts.
- f. Wax and polish finish floors.
- g. Clean all hardware.
- h. Clean all fixtures.
- j. Comply with all special cleaning instructions contained in the Specifications.
- k. Ventilating Systems:
 - i. Clean permanent filters and replace disposable filters if units were operated during construction.
 - ii. Clean ducts, blowers and coils if units were operated without filters during construction.
- l. Remove temporary services, construction equipment, tools and facilities, mock-ups, temporary structures, surplus materials, debris and rubbish from Employer's Property.
- m. Put site in neat, orderly condition, ready for use. Leave all spaces clean and free from debris.
- n. Broom clean exterior paved surfaced; rake clean other surfaces of the grounds.
- p. Prior to final completion, conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean.

EXECUTION REQUIREMENTS (01700) (CONT'D)

D. Starting Systems

1. Coordinate schedule for start-up of various equipment and systems.
2. Notify Engineer, Employer seven days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
4. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify that wiring and support components for equipment are complete and tested.
6. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.
7. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
8. Submit a written report in accordance with Section 01300 that equipment or systems has been properly installed and is functioning correctly.

E. Demonstration and Instructions

1. Demonstrate operation and maintenance of Products to Employer's personnel two weeks prior to date of substantial completion.
2. Demonstrate project equipment and instruct in a classroom environment located at site and instructed by a qualified personnel who is knowledgeable about the Project.
3. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
4. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Employers' personnel in detail to explain all aspects of operation and maintenance.

EXECUTION REQUIREMENTS (01700) (CONT'D)

E. **Demonstration and Instructions (Cont'd)**

5. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time and at equipment location.
6. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
7. The amount of time required for instruction on each item of equipment and system is that specified in individual Sections.

F. **Testing, Adjusting and Balancing**

1. Contractor will appoint, employ and pay for services of an independent firm approved by the Engineer to perform testing, adjusting and balancing.
2. The independent firm will perform services specified in Mechanical Works.
3. Reports will be submitted by the independent firm to the Engineer indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.

G. **Protecting Installed Construction**

1. Protect installed Work and provide special protection where specified in individual Specification Sections.
2. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
3. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
4. Protect floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
5. Prohibit traffic or storage upon waterproofed or roof surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

EXECUTION REQUIREMENTS (01700) (CONT'D)

H. Project Record Documents

1. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - a. Drawings.
 - b. Specifications.
 - c. Addenda.
 - d. Variation Orders and other modifications to the Contract.
 - e. Reviewed Shop Drawings, Product Data, and Samples.
 - f. Manufacturer's instruction for assembly, installation, and adjusting.
2. Ensure entries are complete and accurate, enabling future reference by Employer.
3. Store record documents separate from documents used for construction.
4. Record information concurrent with construction progress.
5. Specifications: Legibly mark and record at each Product Section description of actual Products installed, including the following:
 - a. Manufacturer's name and product model and number.
 - b. Product substitutions or alternates utilized.
 - c. Changes made by Addenda and modifications.
6. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - a. Measured depths of foundations in relation to finish main floor datum.
 - b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - d. Field changes of dimension and detail.
 - e. Details not on original Contract drawings.
7. Submit documents to Engineer with claim for final Application for Payment.

EXECUTION REQUIREMENTS (01700) (CONT'D)

J. Operation and Maintenance Data

1. Format

- a. Prepare instructions and data by personnel experienced in maintenance and operation of described projects.
- b. Prepare data in the form of an instructional manual.
- c. Binders: Commercial quality, binders with durable plastic covers. When multiple binders are used, correlate data into related consistent groupings.
- d. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- e. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- f. Text: Manufacturer's printed data, or typewritten data on 80gr paper.
- g. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- h. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
 - i. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - ii. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

EXECUTION REQUIREMENTS (01700) (CONT'D)

J. Operation and Maintenance Data (Cont'd)

1. Format (Cont'd)

h. (Cont'd)

- iii. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties [and bonds].

j. Submit 1 copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned, with Engineer comments. Revise content of all document sets as required prior to final submission.

k. Submit four sets of revised final volumes in final form within 10 days after final inspection.

2. Contents, each Volume

- a. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- b. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- c. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- d. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- e. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01400.
- f. Warranties: Bind in copy of each.
- g. Bonds: Bind in original of each.

EXECUTION REQUIREMENTS (01700) (CONT'D)**K. Manual for Materials and Finishes**

1. Submit four copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
2. For equipment, or component parts of equipment put into service during construction and operated by Employer, submit documents within ten days after acceptance.
3. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured Products.
4. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
5. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
6. Additional Requirements: As specified in individual Product Specification Sections.
7. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

L. Manual for Equipment and Systems

1. Submit four copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
2. For equipment, or component parts of equipment put into service during construction and operated by Employer, submit documents within ten days after acceptance.
3. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

EXECUTION REQUIREMENTS (01700) (CONT'D)**L. Manual for Equipment and Systems (Cont'd)**

4. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.
5. Include color coded wiring diagrams as installed.
6. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
7. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassemble instructions; and alignment, adjusting, balancing, and checking instructions.
8. Provide servicing and lubrication schedule, and list of lubricants required.
9. Include manufacturer's printed operation and maintenance instructions.
10. Include sequence of operation by controls manufacturer.
11. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
12. Provide control diagrams by controls manufacturer as installed.
13. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
14. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
15. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
16. Include test and balancing reports.
17. Additional Requirements: As specified in individual Product Specification Sections.
18. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

EXECUTION REQUIREMENTS (01700) (CONT'D)

M. **Instruction of Employer Personnel**

1. Before final inspection, instruct Employer's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
2. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
3. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
4. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

N. **Warranties and Bonds**

1. This Section describes the Contractor's responsibility in respect of warranties, guarantees and bonds.
2. The Contractor shall ensure that he receives from manufacturers and suppliers all available warranties, guarantees and bonds that are normally offered with the product, fully completed and documented to assure the whole of the benefits which they offer.
3. All warranties, guarantees and bonds shall run for the stipulated period commencing at the date of the completion of the Contract.
4. Warranties for all mechanical, electrical, waterproofing and other works shall be as called for in the Conditions of Contract.
5. All warranties and bonds shall be submitted to the Engineer or his representative.

P. **Protection and Making Good**

1. The Contractor shall protect all completed Works from damage until the completion of the Works to the approval of the Engineer.
2. Should the Contractor allow any Works to be damaged he shall at his expense make good or replace as required and to the approval of the Engineer.

Q SOIL INVESTIGATION

The soil investigation report is attached but in all cases it will be for reference and guidance only and no guarantee is given regarding its accuracy nor is it guaranteed that similar conditions apply elsewhere on the site.

The Contractor shall ascertain the soil conditions on his own by carrying out necessary soil investigations and tests to determine the nature and characteristics of soil strata, bearing capacities, water table and other data required for the execution of the Works on the Site, for the Contractor's construction operations and for ascertaining the adequacy of sub-surface conditions below foundations and structures. The Contractor is fully and entirely responsible of this works .The sub-surface soil investigation requirement shall be as per Engineer instructions on site after buildings demolition

Such investigations and tests shall be performed in accordance with recognized standards and procedures and conducted at the locations and in the manner approved by the Engineer.

It shall be the responsibility of the Contractor to design and provide design loads at no extra cost and/or time to the Client. The Contractor shall submit all the necessary details of his findings of any adverse conditions and his proposed modifications for the approval of the Consultant before commencing work. However, any such approval accorded shall not relieve the Contractor of any of his contractual obligations and responsibilities.

The cost of this work shall be deemed to be included in the total price

DIVISION 2

SITE WORK

DIVISION 2

SITE WORK

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EXCAVATION & EARTHWORK (02200)

A. **Scope**

1. Included under this section the requirements for checking the achieved levels by previous Contractor and filling between footings.

B. **Performance and Standards**

1. All materials and workmanship shall comply with the latest edition of relevant British Standards and with the Specification.

C. **Related Items**

- 01060 Regulatory Requirements
- 03300 Cast-In-Place Concrete

D. **Submittals**

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.

E. **Product Handling**

Not Applicable.

F. **Materials**

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

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

'Topsoil' shall mean any surface soil which in the opinion of the Engineer is capable of supporting vegetable growth.

'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.

G. Workmanship**1. Site and Sub-soil Conditions**

The Contractor shall be fully responsible for ascertaining all site and sub-soil conditions affecting his Works under the Contract. 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.

2. 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.

3. 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.

EXCAVATION & EARTHWORK (02200) (CONT'D)**G. Workmanship (Cont'd)****3. Maintaining Excavation and Earthworks free from Water (Cont'd)**

The Contractor shall if requested submit his proposals for maintaining the Works free from standing water and obtain the Engineer's approval.

4. Compaction of Areas of Fill

Materials used in areas of fill shall be compacted to comply with the laboratory compaction curve according to ASTM D 1557 as follows except where directed otherwise by the Engineer:-

- (i) For the topmost 600mm below formation level, compact each layer to 95% of maximum dry unit weight.
- (ii) For the remainder below formation level, compact each layer to 90% of maximum dry unit weight.

5. 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

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.

EXCAVATION & EARTHWORK (02200) (CONT'D)

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

6. **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.

7. **Refilling of Foundation Pits and Trenches**

Refilling of foundation pits and trenches 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.

8. **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)**

9. **Granular Sub-Base Underground 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.

DIVISION 3

CONCRETE WORK

DIVISION 3

CONCRETE WORK

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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 BS 8110 : Part 1, ISO 3443 and BS 5606 for tolerances in buildings.

C. **Related Items**

01300 Submittals
03300 Cast-in-Place Concrete

D. **Submittals**

1. Submit shop drawing for all formwork showing locations of tie bolts and cones, openings, chamfers, water stops, 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. Smooth surface finish Formwork**

- a. All concrete works in basements (walls, slabs, ceilings, columns, etc...) shall have smooth finish and shall not receive plaster, unless otherwise indicated on drawings and schedule of finishes.
- b. This shall be obtained by the use of properly designed formwork or moulds of closely jointed plywood boards. The surface shall be free from voids, honeycombing or other large blemishes.

2. Fairface Formwork

- a. This finish shall be obtained by the use of properly designed forms of closely jointed type plywood boards, metal framed, or other acceptable panel type materials, where indicated on the drawings. The surface shall be free from voids, honeycombing or blemishes. The surface shall then be continuous, straight, smooth, improved by carefully removing all fins and other projections.
- b. Forms shall be furnished in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

3. Chamfers and grooves

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

All slabs, drop beams, walls and columns shall have chamfers and grooves where shown on the drawings or as specified by the Engineer .

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. They are designed to prevent form deflection and to prevent spalling of concrete upon removal.

When forms are removed, no metal shall be closer than 40mm from the concrete surface. Provide ties that, when removed, will leave holes not greater than 25mm in diameter in the concrete surface.

5. Form coating

Form coating shall be of a type which does not impart 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. 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. Control of Colour

Where the finished concrete is exposed the Contractor shall obtain each constituent material from a single consistent source. The aggregates shall be durable and free of any impurities that may cause staining. The mix proportions and the grading, particularly of the fine aggregate, shall be maintained constant. In formwork the same type of plywood or timber shall be used throughout similar exposed areas, and individual plywood sheets or sections of timber in large panels shall not be replaced.

7. Release Agents

Release agents for formwork shall be to the approval of the Engineer. Where a concrete surface is to be permanently exposed, only one agent shall be used throughout the entire area. Release agents contact with reinforcement shall be avoided.

8. 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

CONCRETE FORMWORK (03100) (CONT'D)**G. Workmanship (Cont'd)****8. Striking of Formwork (Cont'd)****b. Striking Period**

Where the concrete compressive strength is confirmed by tests on concrete cylinder stored under conditions that simulate the field conditions, formwork supporting concrete in bending may be struck when the cylinder strength is 12N/mm^2 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..

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

	Ordinary Portland Cement Concrete
Sides of columns, walls and beams	2 days
Soffits and slabs	6 days
Soffits of beams	14 days
Props to beams	21 days
Props to slabs	15 days

9. 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.

10. 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.

CAST-IN-PLACE CONCRETE (03300)

PART 1 - GENERAL

A. Related Documents

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Summary

1. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - a. Foundations.
 - b. Suspended slabs.
 - c. Building frame members.
 - d. Building shear walls and columns.
2. Related Sections include the following:
 - a. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

C. Definitions

1. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

D. Submittals

1. Product Data: For each type of product indicated.
2. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - a. Indicate amounts of mixing water to be withheld for later addition at Project site.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 1 – GENERAL (CONT'D)****D. Submittals (Cont'd)**

3. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
4. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
5. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
6. Samples: For waterstops and vapor retarder.
7. Welding certificates.
8. Qualification Data: For Installer, manufacturer and testing agency.
9. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - a. Aggregates.
 - b. Cement.
 - c. Steel reinforcement.
10. Material Certificates: For each of the following, signed by manufacturers:
 - a. Cementitious materials.
 - b. Admixtures.
 - c. Form materials and form-release agents.
 - d. Steel reinforcement and accessories.
 - e. Waterstops.
 - f. Curing compounds.
 - g. Floor and slab treatments.
 - h. Bonding agents.
 - i. Adhesives.
 - j. Vapor retarders.
 - k. Semirigid joint filler.
 - l. Joint-filler strips.
 - m. Repair materials.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 1 – GENERAL (CONT'D)

D. Submittals (Cont'd)

11. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
12. Field quality-control test and inspection reports.
13. Minutes of preinstallation conference.
14. *Equipment used for mixing, concreting, pumping, and placing of concrete.*

E. Quality Assurance

1. **Installer Qualifications:** A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
2. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
3. **Testing Agency Qualifications:** An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
4. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
5. **Welding:** Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 1 – GENERAL (CONT'D)

*E. **Quality Assurance (Cont'd)***

6. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - a. ACI 301, "Specification for Structural Concrete," Sections 1 through 5
 - b. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
7. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
8. Mockups: Cast concrete panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - a. Build panel approximately in the location indicated or, if not indicated, as directed by Engineer.
 - b. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.
9. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - a. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - i. Contractor's superintendent.
 - ii. Independent testing agency responsible for concrete design mixtures.
 - iii. Ready-mix concrete manufacturer.
 - iv. Concrete subcontractor.
 - b. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 1 – GENERAL (CONT'D)****F. Delivery, Storage, and Handling**

1. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
2. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

G. Testing and Material Requirements

1. All materials to be used in concrete, mortar or plaster works shall conform to test requirements of the following Standards, and the Contractor shall perform any of these tests as required by the Engineer in an approved independent Laboratory. Test results bearing the signature of the Laboratory shall be submitted to the Engineer.
2. The Contractor shall follow the guidelines contained in the latest editions of the codes, specifications and standards listed below, except where more stringent requirements are shown or specified.

ASTM C 29	Bulk density of aggregates
ASTM C 31	Making and Curing Concrete Test Specimens in the Field.
ASTM C 33	Standard Specification for Concrete Aggregates.
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 40	Organic Impurities in Sands for Concrete.
ASTM C 42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
ASTM C 78	Flexural Strength of Concrete.
ASTM C 87	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
ASTM C 88	Soundness of Aggregates by Use of Sodium or Magnesium Sulfate
ASTM C 94	Ready-Mixed Concrete
ASTM C 109	Standard Method of Test for compressive strength of Hydraulic Cement Mortars (Using 2-in. (50mm) Cube Specimens)
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by use of the Los Angeles Machine.
ASTM C 117	Materials fine than 0.075 mm (No. 200) sieve
ASTM C 123	Lightweight Pieces in aggregates

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 1 – GENERAL (CONT'D)****G. Testing and Material Requirements (Cont'd)**

ASTM C 125	Terminology relating to concrete and concrete aggregates
ASTM C 127	Specific Gravity and Water Absorption of Coarse Aggregate.
ASTM C 128	Specific Gravity and Water Absorption of Fine Aggregate.
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate.
ASTM C 138	Unit Weight, Yield, and air content (Gravimetric) of Concrete.
ASTM C 142	Clay Lumps and Friable Particles
ASTM C 143	Slump of Portland Cement Concrete.
ASTM C 150	Portland Cement.
ASTM C 171	Sheet Materials for Curing Concrete.
ASTM C 172	Sampling Fresh Concrete.
ASTM C 174	Measuring Length of Drilled Concrete Cores.
ASTM C 192	Making and Curing Concrete Test Specimens in the Laboratory.
ASTM C 231	Air Content of freshly mixed concrete using pressure meter
ASTM C 232	Bleeding of concrete
ASTM C 260	Air-entraining Admixtures for Concrete.
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 330	Standard Specification for Lightweight Aggregates for Structural Concrete.
ASTM C 403	Determination of concrete setting time
ASTM C 494	Chemical Admixtures for Concrete.
ASTM C 566	Total water content in aggregates
ASTM C 595	Standard Specification for Blended Hydraulic Cements.
ASTM C 617	Capping cylindrical concrete specimen
ASTM C 685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
ASTM C1017	Chemical Admixtures for Use in Producing Flowing Concrete
ASTM D 98	Calcium Chloride
ASTM D 1751	Performed Expansion Joint Fillers for Concrete Paving and Structural Construction.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 1 – GENERAL (CONT'D)****G. Testing and Material Requirements (Cont'd)**

ASTM D 2419	Sand Equivalent of Fine Aggregates
ASTM A 185	Welded Steel Wire Fabric for Concrete Reinforcement.
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete reinforcement.
ASTM A 998	Rail Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM A 617	Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
ACI	(American concrete Institute)
ACI 201.2R	Guide to Durable Concrete
ACI 211	Recommended Practice for Selection proportions for Normal and Heavy-Weight Concrete.
ACI 214	Quality Control Charts
ACI 221	Guide for use of Normal weight and Heavyweight Aggregates in Concrete
ACI 222	Protection of Metals in Concrete against Corrosion
ACI 304.2	Placing Concrete by Pumping
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304	Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
ACI 305	Hot Weather Concreting.
ACI 308	Guide to Curing of Concrete.
ACI 309	Recommended Practice for consolidation of Concrete.
ACI 318	Building Code Requirements for Reinforced Concrete.
ACI 347	Recommended Practice for Concrete Formwork
BS EN	(British and European Standards)
BS 1881: Part 122	Water absorption of concrete
BS 1881: Part 208	Initial Surface Water Absorption
BS EN 12390-8	Water Permeability of Concrete
BS EN 1744	Chemical properties of aggregates

H. Method Statement

1. During the mobilization period the Contractor shall submit a method statement detailing his proposal for the organization of all concreting activities at the site as well as off site for the approval of the Engineer.
2. The Contractor shall submit a method statement for any particular activity when called for by the Engineer and demonstrate its feasibility through mockups or placement samples of appropriate size as approved and directed by the Engineer.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS

A. **Cement**

1. **General**

- a. Cement shall be Portland or Blended Type, originating from approved manufacturers, obtained in sealed and labeled bags, each 50 kgs net capacity, name and brand of the manufacturer shall plainly be identified thereon and delivered to Site in good condition.
- b. Cement delivered in bulk shall be accepted only if a central mixing plant is used. The quality of cement shall conform to the Standard Specification of ASTM C 150 Type I for use in general concrete construction or ASTM C595 Blended Cement.
- c. The use one brand of cement will be permitted throughout the project unless otherwise approved by the Engineer.
- d. Manufacturer testing certificate (Mill Certificate) shall be provided with each bulk shipment and made available to the Site. The Engineer shall have the right to call for additional testing, the cost of which is to be born by the Contractor.

2. **Storage of Cement**

- a. All cement shall be stored in suitable weatherproof and approved storage sheds which will protect the cement from dampness. These storage sheds shall be erected in locations approved by the Engineer.
- b. Provisions for storage shall be ample, and the consignment of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each consignment.
- c. Cement shall be used in the order of its delivery to the site; new deliveries shall not be used unless the cement from earlier deliveries has been completely used.
- d. Stored cement shall meet the test requirements at any time after storage when a retest is ordered by the Engineer, all at the expense of the Contractor.
- e. Storage of bulk cement shall be tight and weatherproof and shall bear a clear indication of the types of the bulked cement. Where storage is provided for different types of cement, isolation to prevent intermingling or contamination is necessary.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****A. Cement (Cont'd)****2. Storage of Cement (Cont'd)**

- f. Cement in bags shall be stored in stacks not more than six bags high. The floor shall be raised above the surrounding ground level (450mm) and constructed to avoid moisture rise. All cement shall be free flowing and free of lumps and presence of moisture. Cement in bags shall be used in the order of delivery. Cement from broken bags shall not be used.
- g. The Contractor shall keep accurate records of the deliveries of cement and of its use in the work. Copies of these records shall be supplied to the Engineer in such form as may be required.

3. Expansion Due to Sulfate Exposure

- a. The expansion in (14) days shall be less than 0.040 percent when tested in accordance with "Standard Method of Test for Potential Expansion of Portland Cement Mortars Exposed to Sulfate" ASTM C 452.

4. Autoclave Expansion

The autoclave expansion shall not exceed 0.80 percent when tested in accordance with "Standard Method of Test for Autoclave Expansion of Portland Cement" ASTM C 151.

5. Routine Testing

Samples of cement shall be obtained from deliveries for routine testing, in accordance with ASTM relevant standards, at the frequencies stated below or whenever requested by the Engineer:

<u>Test Description</u>	<u>Period of Testing</u>
Fineness of Cement by Blaine	Weekly
Setting Time and Consistency of Cement	Monthly
Chemical Analysis	Once every 3 Months
Compressive Strength of Cement	Once every 3 Months

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

A. **Cement (Cont'd)**

6. **Rejection**

- a. The Contractor shall notify the Engineer of dates of delivery so that there will be sufficient time for sampling the cement, either at the mill or upon delivery.
- b. The provisional acceptance of the cement at the mill shall not deprive the Engineer of the right to reject it on the basis of a retest of any of the specified properties at the time of delivery of the cement to the Site.
- c. Packages of cement varying by 2% or more from the specified weight shall be rejected and if the average weight of packages in any consignment, as shown by weighing 50 packages taken at random, is less than that specified, the entire consignment shall be rejected and the Contractor shall remove it forthwith from the Site at his own expense and replace it with cement of satisfactory quality.
- d. Stale cement or cement reclaimed from cleaning bags shall not be used. Cement which for any reason has become partially set, or contains lumps or caked cement, shall be rejected.
- e. Cement not complying with the requirements of ASTM C150 specifications shall be rejected. Blended cement must comply with ASTM C 595 specifications.
- f. Cement stored for more than 3 months from the production date shall not be used.

B. **Aggregates**

1. **General Requirements**

All aggregates shall consist of tough, hard, durable uncoated particles. The Contractor shall be responsible for the processing of this material to meet the requirements of the specifications. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to provide concrete of having the minimum strength specified.

2. **Storage**

- a. Coarse and fine aggregates shall be delivered and stored separately on site in such a manner as to prevent segregation and contamination or the intrusion of foreign materials.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)**

- b. Aggregate which has become segregated or contaminated with foreign matter during storage or handling will be rejected and shall be removed and replaced with material of acceptable quality at the Contractor's expense. Aggregates of the quality and color selected shall be stored in sufficient quantity to avoid interruption of concreting work at any time.
- c. Delivered aggregates shall be kept separate from previous batches, and shall be stored for at least three working days before use to allow for inspection and relevant tests to be carried out. Sampling of aggregate shall be conducted randomly from stockpiles/bins.

C. Fine Aggregate**1. General Requirements**

- a. All fine aggregate for concrete shall conform to Standard Specification for Concrete Aggregates of ASTM C 33.
- b. It shall not contain harmful materials such as iron pyrites, coal, mica, shale, alkali, coated grains, or similar laminated materials such as soft and flaky particles, or any material which may attack the reinforcement, in such a form and in sufficient quantity to affect adversely the strength and durability of the concrete. Fine Aggregate passing sieve No. 4 (size 4.75 mm) shall not contain any voided shells.
- c. Fine aggregates shall be washed thoroughly with demineralized water to ensure compliance with the appropriate requirements and limitations of the specifications.
- d. Fine aggregate from different sources of supply shall not be mixed or stored in one pile nor used alternately in the same class of construction or mix.
- e. The Fineness Modulus of fine aggregate shall be between 2.50 and 3.10.
- f. The Material Finer than No. 200 (0.075 mm) sieve shall not be in excess of 3 % by weight for concrete subject to abrasion and 5% by weight for all other concrete. In the case of manufactured sand, if the material finer than the 75- μ m (No. 200) sieve consists of the dust of fracture, essentially free of clay or shale, these limits are permitted to be increased to 5% and 7 %, respectively
- g. In testing for Organic Impurities in fine aggregate, the color shall be lighter than standard color and shall have an intensity not darker than two-thirds that of the standard color solution. (Not darker than Plate 2 as determined by the Standard Method of Test for Organic Impurities in Sands for Concrete) of ASTM C-40.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)**

- h. Chlorides soluble in dilute Nitric Acid shall not be more than 0.10 percent by weight when expressed as sodium chloride (NaCl).
- i. Total Acid Soluble Sulfates shall not exceed 0.50 percent by weight when expressed as sulfur trioxide (SO₃).
- j. Mortar Strength using the fine aggregate shall have a Compression Ratio not less than 95%.
- k. In testing for Soundness, the weighted average loss when subjected to 5 cycles of the soundness test using sodium sulfate shall be less than 10%.
- l. Sand equivalent when tested in accordance with ASTM D 2419 shall not be less than 50%.

D. Coarse Aggregates**1. General Requirements**

- a. All coarse aggregate for concrete shall conform to Standard Specifications for Concrete Aggregates of ASTM Designation: C 33.
- b. Coarse aggregate shall consist of gravel, crushed gravel, or crushed stone, having hard, strong durable pieces, free from undesirable material and obtained from an approved source.
- c. Coarse aggregate shall not contain harmful materials such as iron pyrites, coal, mica, alkali, laminated materials, or any material which may attack the reinforcement, in such a form or in sufficient quantity to affect adversely the strength and durability of the Concrete.
- d. Coarse aggregates shall be washed thoroughly with demineralized water to ensure compliance with the appropriate requirements and limitations of the specifications.
- e. Deleterious Substances

The amount of deleterious substances shall not exceed the following limits:

Max. Permissible Limit	(% by Weight)
• Soft fragments	2.0
• Coal and lignite	0.5
• Clay lumps	0.25
• Materials passing the No. 200 sieve	1.0

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****D. Coarse Aggregates (Cont'd)****1. General Requirements (Cont'd)**

This percentage can be increased to 1.5% if the material is essentially free of clay or shale; or if the source of the fine aggregate to be used in the concrete is known to contain less than the specified maximum amount passing the 75- μ m (No. 200) sieve

- | | |
|--|------|
| • Thin or elongated pieces (length greater than 5 times average thickness) | 4.0 |
| • Other local deleterious substances, chlorides soluble in dilute Nitric acid when expressed as sodium Chloride (NaCl) | 0.05 |
| • Total acid soluble sulfates when expressed as sulfur trioxide (SO ₃) | 0.5 |

Physical Property Requirements for Coarse Aggregate:

Maximum Limit (% by Weight)

- | | |
|------------------------------|----|
| • Abrasion | 30 |
| • Soundness (Sodium Sulfate) | 10 |

2. Grading

Coarse aggregates shall be supplied in the nominal sizes specified and shall be graded in accordance with ASTM C 33.

E. Combined Aggregate

1. Approved fine and coarse aggregate in each batch of concrete shall be combined in proportions according to test results and as approved by the Engineer, giving the required compressive concrete strength as specified per type of Concrete.
2. Changes from one combined gradation to another shall not be made during the progress of the work unless approved by the Engineer. Such changes shall be approved only after being validated by test trials.
3. If the grading of any of the aggregate alters to such an extent that the fraction of combined aggregate retained on any sieve cannot be maintained within two percent of the original combined aggregate grading, then further trial mixes of concrete shall be made, tested and approved for use.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****E. Combined Aggregate (Cont'd)**

4. No part of the aggregates shall contain any mineral known to have a potential to cause alkali silica, alkali carbonate or any other damaging chemical reactions between alkalis and aggregates.
5. In no case shall materials passing the 0.075 mm sieve exceed 3.5 % by weight of the combined aggregate.
6. When two consecutive averages of five tests fall outside the specified limits, the contractor shall take immediate steps, including a halt to production, until remedy.
7. Aggregates shall be frequently tested and shall comply with the requirements stated in Table 1

Table1. Minimum testing requirements for aggregates to be used in concrete

Test description	Frequency	Test method	Permissible limit	
		ASTM	Fine	Coarse
Grading	Twice per week	C136	Standard	Standard
Material finer than 0.075 mm	Twice per week	C117	Max. 3% ^a	Max. 1%
Clay lumps and friable particles	Once per 3 months	C142	Max.2	
Lightweight pieces	Once per 3 months	C123	Max. 0.5	
Organic impurities	Twice per week	C87	Lighter than standard color	N.A

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****E. Combined Aggregate (Cont'd)***

Acid Soluble chlorides:				
a. Prestressed concrete and steam cured structural concrete	Once per month	BS 1744	Max. 0.01%	Max. 0.01%
b. Other			Max. 0.05%	Max. 0.03%
Acid soluble sulfate	Once per month	BS 1744	Max. 0.3%	Max. 0.3%
Soundness	Once per 3 months	C88	Max. 10	Max. 10
Los Angeles Abrasion	Once per 3 months	C131	N.A	Max. 30
Specific gravity and water absorption	Every two weeks	C127 & 128	2%	2%
Potential reactivity	At the start of the project once/year	C289	Not reactive	Not reactive
		C227	6 month expansion 0.1% Max.	
Sand equivalent	Twice per week	D2419	Not less than 50	N.A ^b

a. Refer to clause 1.5.D.6

b. Not Applicable

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

F. Water

1. Requirements and Testing

- a. Water for mixing concrete shall be fresh, clean and free from injurious amounts of oil, acid, or any other deleterious mineral and/or organic matter.
- b. The water to be used in concrete, including wash water, shall be clean and free from harmful matter in suspension or solution and shall satisfy the recommendations given in ASTM C 1602 "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete".
- c. Potable water can be used as mixing water in concrete without testing it for conformance with the required specification.
- d. Non-potable sources of water shall be qualified for use in accordance with the following:
 - i. Water shall be tested for compliance with Table 2 before first use and thereafter every three months or more often when there is reason to believe that a change has occurred in the characteristics of source. Testing is permitted to be at a lower frequency, but not less than annually when results from four consecutive tests indicate compliance with table 2.
 - ii. The manufacturer shall maintain documented evidence that the characteristics of the combined mixing water are in compliance with Table 3. These tests shall be conducted before first use and thereafter every 6 months or more often when there is reason to believe that a change has occurred in the characteristics of the source. These records shall be provided to the Engineer upon his request.
 - iii. The frequency of testing shall be as mentioned above or whenever specified by the Engineer. The cost of such testing shall be born by the Contractor.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****F. Water (Cont'd)****TABLE 2 Concrete Performance Requirements for Mixing Water**

	<u>Limits</u>
Compressive strength, min % control at 7 days ^{a b}	90
Time of set, deviation from control, h: min ^a	From 1:00 early To 1:30 later

- a. Comparisons shall be based on fixed proportions for a concrete mix design representative of questionable water supply and a control mix using 100 % potable water or distilled water
- b. Compressive strength results shall be based on at least two standard test specimens made from a composite sample.

TABLE 3 Chemical Limits for Combined Mixing Water

	<u>Limits</u>
Maximum concentration in combined mixing water, ppm ^a	
a. Chloride as Cl-, ppm	
i. In prestressed concrete, bridge decks, or otherwise designated	500b
ii. Other reinforced concrete in moist environments or containing aluminum embedment or dissimilar metals or with stay-in-place	1000b
iii. galvanized metal forms	
b. Sulfate as SO ₄ , ppm	3000
c. Alkalies as (Na ₂ O + 0.658 K ₂ O), ppm	600
d. Total Solids by mass, ppm	50 000
i- ppm is the abbreviation for parts per million	
ii- The requirements for concrete in ACI 318 shall govern when the manufacturer can demonstrate that these limits for mixing water can be exceeded. For conditions allowing the use of calcium chloride (CaCl ₂) accelerator as an admixture, the chloride limitation can be waived by the Engineer.	
e. The pH of the water for mixing and curing of concrete shall not be less than pH 4.5 or more than pH 8.5.	
f. In sampling water for testing, care shall be taken to ensure that the containers are clean and that samples are representative.	

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

G. Admixtures

1. Admixtures and additives shall be used only with the prior approval of the Engineer. Additives shall be subjected to tests before approval and during progress of work on site at the discretion of the Engineer. All costs incurred towards all such tests shall be borne by the Contractor.
2. The proposed dosage and method of use shall be submitted to the Engineer together with the following data:
 - a. Compliance of the admixture with ASTM C 494 as a job mix. The typical dosage and detrimental effects of under-dosage and over-dosage
 - b. The chemical name(s) of the main active ingredient(s) in the admixture
3. Admixtures shall conform to one of the following standards:
 - a. ASTM C 494 Chemical Admixtures for Concrete.
 - b. ASTM C 1017 Chemical Admixtures for Use in Producing Flowing Concrete.
4. Admixtures/Additive shall:
 - a. Have no adverse effect on the shrinkage and water tightness properties of finished concrete.
 - b. Not have any added chloride (0%, calculated as calcium chloride by weight of cement in the concrete).
5. The Contractor shall submit results of concrete trial mix-(es) clearly specifying the intended dosage of admixture with necessary documentation. Trial mixes shall be carried out or verified by an approved independent laboratory.
6. The contractor shall substantiate the performance of admixture every 3 months period to verify the type of admixture being used and its consistency. Samples shall be selected in the presence of the Engineer and tests shall be conducted at an independent testing agency.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****G. Admixtures (Cont'd)**

7. Moreover, routine testing of the following properties shall be conducted frequently as per the referred testing methods in ASTM C494:

<u>Test Description</u>	<u>Period of Testing</u>
pH value	Once per Week
Specific Gravity	Once per Week
Solid Content	Once per Month
Setting Time of concrete	Once per 3 Months

H. Concrete for Structures

1. Classes of concrete to be used in the Works shall in general be as shown in Table 4. Where different classes of concrete are required, the design of the mix shall follow the requirements of this specification.
2. Where adequate workability is difficult to obtain at the maximum water-cementitious ratio allowed, the use of plasticizers or water reducing admixtures shall be considered. Alternatively an increase in cementitious content may be considered at the discretion of the Engineer. Cementitious contents in excess of 500 kg/m³ shall not be used unless approved by the Engineer
3. The Contractor shall comply with the recommendations of ACI 318 unless specifically excluded or modified thereafter.
4. Each mix design shall be such that:
 - i. The aggregate shall comprise fine aggregate and coarse aggregate no greater than the maximum size specified in ACI 318 section 3.3
 - ii. The combined aggregate grading shall be smooth and continuous
 - iii. The aggregate batch quantity shall be calculated by weight
 - iv. The mixes shall be proportioned to produce consistent concrete cylinder compressive strength at twenty-eight days after manufacture as stated in ACI 318 sec. 5.6.3.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****H. Concrete for Structures (Cont'd)****Table 4 Mix Description**

Class of concrete	Purpose	Method of placing	f' c cylinder (MPa)	Max. Slump (mm)	Indicative concrete Mix	Max. RCP ASTM C1202	Max. Water permeability (mm)	Max. ISAT at 10 min (ml/m ² .s)	30 min. Water Absorption (%)	Min. Cementitious Content Kg/m ³	Max. Water / Cementitious ratio
A	Blinding	Pump	17	N.R.	OPC	-----	-----	-----	-----	-----	0.6-
B,C,D&F	Reinforced Concrete for Foundations, ground slabs, slabs, and basemnet walls	Pump	35	150	OPC	200	10	0.05	10	350	0.40
E	Columns & shear walls	Pump	40	150	OPC	200	10	0.05	10	350	0.40

Notes:

The above concrete mix types and minimum cement content are suggested by the Engineer.

The slump test shall not be, at any case, more than 230 mm Abbreviations:

OPC: Ordinary Portland Cement (ASTM C 150 Type I or equivalent)

N.R. : Not Required

5. At the start of the construction period, the Contractor shall design a mix for each class of concrete listed in Table 4 as required in the works.
6. The concrete mix design proposed by the Contractor shall satisfy the required target strength as per ACI 318 sec. 5.3.2
7. The thickness of the blinding concrete shall be as shown on the Drawings, but shall be not less than 75 mm.
8. Chloride level in concrete mix shall comply with the requirements of Table 5.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****H. Concrete for Structures (Cont'd)**

Table 5 Chloride limits

Type of concrete	% By weight of cement
	Chlorides as Cl ^{- a}
For reinforced concrete if made with OPC/MSRPC if made with SRPC	max. 0.30 max. 0.15
Prestressed concrete and heat-cured reinforced concrete	max. 0.10
For mass concrete if made with OPC/MSRPC if made with SRPC	max. 0.60 max. 0.15

- a. Any chloride content present in the cement has to be taken into account while computing total chloride ion in the mix.

I. Proportions

1. After the materials provided by the Contractor have been accepted for the works, the proportions and equivalent batch weights shall be determined.
2. The contractor shall prepare and submit comprehensive concrete mix design reports along with test results for the different types and classes of concrete to the Engineer for review. Laboratory trials shall be conducted at an independent testing Laboratory as per ASTM C192 at least 35 days before commencement of concreting.
3. As soon as the Engineer has approved the concrete mix design for each class of concrete, the Contractor shall also conduct a field trial mix for each class in the presence of the Engineer to record and verify that the test results on fresh concrete are equivalent to those obtained in the Laboratory trials. Field trial mixes shall be mixed for the same mixing time and handled by means of the same batching plant which the Contractor proposes to use in the Works. Each field trial mix shall comprise not less than 0.5 m³ of concrete. Slump test measurements shall be taken immediately after mixing and evaluated in accordance with the tolerances of ASTM C 94.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****I. Proportions (Cont'd)***

4. The Contractor shall make three separate batches for each trial mix; and six 150mm by 300mm compression test cylinders shall be sampled from each batch in the presence of the Engineer. Three cylinders shall be tested at 7 days and three at 28 days, after manufacture in accordance with the method described in ASTM. The average of each set of three cylinders from each batch is considered one set. The ratio of the 7 to 28 days tests will be used as an indicative reference during the progress of the works when early assessment of the concrete strength is needed. If either or both the average value of the three tests at 28 days is less than the design strength given in Table 4, or the difference between the greatest and the least tests is more than 20 % of the average strength of the three tests at 28 days, the Contractor shall:
 - a. Remove from site the materials from which the trial mix was prepared
 - b. Provide new materials and prepare and test further trial mixes until specified requirements are achieved.
5. Additionally, the Contractor shall measure the temperature, workability and density of concrete in each batch and he shall conduct the bleeding test on the fresh concrete sample in accordance with ASTM C 232. The rate of bleeding determined will be used as a reference when assessing the probability of plastic cracks during hot or windy weathers.
6. A full scale trial mix for each class of concrete shall also be conducted by the Contractor in the presence of the Engineer to check for the workability retention of the concrete. Each trial mix shall be batched, mixed and then transported a representative distance simulating the condition that the Contractor proposes to use in batching, mixing and transporting the concrete to be placed in the Works.
7. If requested by the Engineer, the concrete shall be placed and compacted in mockup of sufficient size not less than three cubic meters. The sides of the moulds used in the mockup shall be capable of being stripped without undue disturbance of the concrete placed therein. The sides of the moulds shall be stripped after the concrete has set and the workability judged based on the visual inspection of the compaction and surface finish obtained. If the mockup shows that the workability required is not attained in any of the trial mixes for a certain class of concrete, the mix shall be redesigned by the Contractor and a further full scale workability test shall be undertaken for that particular class of concrete.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****I. Proportions (Cont'd)***

8. Redesign, making and preliminary testing of concrete mixes shall be repeated for each class of concrete until they meet the requirements of Table 4.

J. Quality and Testing

1. In order to ensure that the quality of materials and mix proportions is maintained throughout concreting operations, sampling and testing shall be carried out using the relevant procedures set out in the relevant ASTM standards and applicable codes referenced in this specification and in accordance with a routine testing program that shall be agreed upon with the Engineer before the start of concrete work.
2. Unless otherwise directed by the Engineer, the routine testing program shall include at least the tests specified below.
 - a. Strength Tests
 - i. The compression test shall be performed based on standard specification for compressive strength of cylindrical concrete specimens of ASTM C 39. Test cylinders made in the field shall have a diameter of 6" (150mm) and a length of 12" (300mm) in accordance with ASTM C 31.
 - ii. Samples shall be obtained in accordance with ASTM C 172. One test set must consist of at least two test specimens, to be tested at each age.
 - iii. The test age for concrete cylinders shall be 7 and 28 days or the age designated for determination of the specified value of f'_c or when specified at the earliest age at which the concrete will receive its full load or maximum stress. Acceptance strength tests are those made on cylinders tested at 28 days.
 - iv. The Engineer may request for additional cylinders to be made for testing at three days or any other age, as and whenever he deems this necessary.
 - v. The compressive strength of cylinders at twenty-eight days after manufacture shall comply with the requirements of ACI 318 sec. 5.6.3

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****J. Quality and Testing (Cont'd)***

- vi. The specimens cured under laboratory conditions shall be considered for acceptance of the concrete in the structure so represented. The field cured cylinders shall be used for the control of curing and to determine when the structure may be put in service. Those cylinder specimens used to control transfer of prestressing force and early handling conditions shall be field-cured under the same conditions as the concrete placed in the field.
- vii. Protecting and curing concrete shall be improved when strength of field-cured cylinders at test age designated for determination of f'_c is less than 85 percent of that of companion laboratory-cured cylinders. The 85 percent limitation shall not apply if field-cured strength exceeds f'_c by more than 3.5 MPa.
- viii. Compressive strength tests shall be performed on concrete samples obtained at the time of placement. The specimens shall be sampled at the following average rates:
 - a. For Blinding:

At least one set of test specimens shall be obtained for each 50 m³ of concrete placed, with at least one set for each day's production.
 - b. For Foundation:

At least one set of test specimens shall be obtained for each 100 m³ of concrete placed, with at least one set for each day's production.
 - c. For other elements of the structure:

At least one set of test specimens shall be obtained for each 40 m³ of concrete placed or fraction thereof, with at least one set for each day's production for each class of concrete.
- ix. All strength tests shall be carried out on laboratory cured specimens at an independent testing laboratory approved by the Engineer at the Contractor's own expense.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****J. Quality and Testing (Cont'd)***

- x. Where the results of strength tests specimens indicate that the concrete does not meet the requirements of ACI 318 sec 5.6.3.3 or if tests of field-cured cylinders indicate deficiencies in protection and curing; concrete core tests, conforming to ASTM C 42 shall be performed, as directed by the Engineer, at the Contractor's expense. Cores shall be evaluated in accordance with ACI 318 sec 5.6.5
3. Durability Tests
- a. The durability tests listed in Table 4 shall be carried out on a trial mix of the proposed mix design using all the envisaged constituent materials and aggregates. All durability testing shall be carried out by an approved independent testing laboratory. In all cases, more than one specimen shall be prepared and tested to provide an indication of the precision of the test method. The testing laboratory shall prepare a comprehensive summary report for durability tests.
 - b. One sample for durability tests shall be taken for each 1000 m³ from each class of concrete but not less than one test per month or as requested by the Engineer, all at the Contractor's expense.
4. Tests on fresh concrete
- a. The contractor shall provide the Engineer all reasonable access and assistance, without charge, for the procurement of samples of fresh concrete at the time of placement to determine conformance to this specification.
 - b. Tests of concrete required to determine compliance with this specification shall be conducted by a certified ACI Concrete Field Testing Technician, Grade I or equivalent.
 - c. Routine tests for fresh concrete include slump, air content, temperature and density. The routine tests shall be carried out in accordance with ASTM standards.
 - d. The slump of a concrete mixture proportion shall be limited to the minimum slump that is consistent with the placement requirements and methods.
 - e. Routine tests shall be performed at the time of placement when strength samples are obtained or whenever the possibility of an inappropriate slump exists.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****J. Quality and Testing (Cont'd)***

- f. For each trial mix, a plant production trial shall be carried out and the slump of the concrete shall be measured immediately after discharge from the mixer and thereafter at 15 minutes interval up to the maximum time period envisaged for delivery and standing on site. Based on this trial, the mix design shall identify any adjustments to the range of the plasticizer used to achieve the desirable workability for different time intervals after batching.
 - g. The slump, temperature, density and air content of the concrete shall be checked from the first concrete trucks produced. If concrete shows consistent results, tests for slump, density and air content will be checked at least once every 50 m³ of concrete poured. The initial slump at the batching plant shall be recorded on the delivery ticket along with the time of the test.
 - h. If the measured slump is greater than the specified upper limit, a check test shall be made immediately on a new test sample. In the event the check test fails, the concrete shall be considered to have failed the requirements of the specification.
 - i. If the measured slump is less than the lower limit, adjustment is permitted by the use of an approved high range water reducer. If the sample of the adjusted concrete fails, a check test shall be made immediately on a new sample of the adjusted concrete. In the event the check test fails, the concrete shall be considered to have failed the requirements of the specification.
 - j. In the event of high variability of slump values or density, the Engineer may instruct that each truck of concrete is checked at the plant. The Contractor shall carry out an investigation to establish the cause of the high variation in slump and shall take necessary corrective actions.
5. Records
- a. Records on testing of materials shall be kept by the Contractor and a copy of each of the test results shall be supplied to the Engineer.
 - b. The 'record form' shall include, but not be limited to, the following information as appropriate: Source of material, aggregate physical and chemical analysis tests, compatibility tests, date and time of mix, batch number, ambient temperature, concrete mix temperature, concrete class, structural member where the concrete is placed, compressive strength results, allowable concrete strength, and method of curing used.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****K. Measurement of Materials***

1. Cement and Mineral Admixtures
2. Except as otherwise specifically permitted, cement shall be measured by mass. When mineral admixtures (including GGBS, silica fume, or other pozzolans) are used, the cumulative mass can be measured along with cement but in a batch hopper and on a scale which is separate and distinct from those used for other materials.
3. The mass of the cement shall be measured before mineral admixtures. The quantity of the cement shall be within ± 1 % of the required mass, and the cumulative quantity of cement plus mineral admixtures shall also be within ± 1 % of the required mass.
4. Under special circumstances approved by the Engineer, cement can be measured in bags of standard mass. No fraction of a bag of cement shall be used unless its mass has been determined.

L. Aggregates

1. Aggregate shall be measured by mass. The quantity of aggregate used in any batch of concrete as indicated by the scale shall be within ± 2 % of the required mass when the mass is measured in individual aggregate weigh batchers.
2. In a cumulative aggregate weigh batcher, the cumulative weight after each successive weighing shall be within ± 1 % of the required cumulative amount.

M. Water

1. Mixing water shall consist of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures.
2. The added water shall be measured by weight or volume to an accuracy of 1 % of the required total mixing water. Added ice shall be measured by weight.
3. In the case of truck mixers, the wash water shall be discharged prior to loading the next batch of concrete.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

N. **Admixtures**

1. Liquid admixtures shall be batched by mass or volume with an accuracy of $\pm 3\%$ of the total amount required or plus or minus the amount or dosage required for 50 kg of cement, whichever is greater.
2. All measuring devices shall be subject to the Engineer's approval.
3. Should any variation from the above mentioned specification occur, reference should be made to ASTM C 94 "Standard Specification for Ready-Mixed Concrete" section 8.

O. **Batching of Concrete**

1. Unless otherwise authorized by the Engineer, concrete shall be mixed in an automated stationary mixer.
2. The concrete temperature shall be kept as low as practical to improve placement and structural qualities, but at no time should the temperature of the concrete delivered to the site be below 5 °C.
3. During measurement operations, aggregates shall be handled in a consistent manner to maintain their desired grading, and keep them well separated, with no contamination. All materials shall be weighed to the tolerances required for the desired reproducibility of the selected concrete mix.
4. Sequencing and blending of the ingredients during charging of the mixers shall be carried out in such a way as to obtain uniformity and homogeneity in the concrete produced. The homogeneity is indicated by concrete physical properties such as density, slump, air content, and strength of concrete from successive batches of the same mix proportions in accordance with ASTM C94
5. Plant Type
 - i. Semi-automatic control batching plants are acceptable. In this system, aggregate bin gates for charging batchers are opened by manually operated push buttons or switches. Gates are closed automatically when the designated weight of material has been delivered
 - ii. Automatic control batching plants are recommended. Automatic batching of all materials is electrically activated by a single starter switch. However, interlocks shall interrupt the batching cycle when the scale has not returned to $\pm 0.3\%$ of zero balance or when weighing tolerances detailed in Clause 1.10 of this Part are exceeded.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

P. Bins and Weight Batchers

1. Batch plant bins shall be of sufficient size to effectively accommodate the production capacity of the plant. Compartments in bins separate the various concrete materials, and the shape and arrangement of aggregate bins shall prevent aggregate segregation and leakage.
2. Gates used to charge semi-automatic and fully automatic batchers shall be power operated and equipped with a suitable in flight correction to obtain the desired weighing accuracy. They shall be calibrated by the plant supplier or an independent laboratory for the types of aggregate used at the standard range of moisture contents.
3. Weigh batchers shall be accessible for obtaining representative samples, and they shall be arranged to obtain the proper sequencing and blending of aggregates during charging of the mixer.
4. The amount of concrete mixed in any one batch shall not exceed the rated capacity of the mixer.
5. On cessation of work, including all stoppages exceeding 20 min, the mixers and all handling plant shall be washed with clean water.
6. All mixing and batching plants shall be maintained free of set concrete or cement and shall be clean before commencing mixing.
7. For each different type of cement at use at the plant, a separate silo shall be provided.
8. The time allowed for mixing (after all the materials have been placed in the mixer) shall be sufficient for thorough mixing to take place. No hand mixing of concrete shall be allowed.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

Q. **Mixing of Concrete**

1. Water shall enter the mixer first with continuous flow while other ingredients are entering the mixer. Water charging pipes must be of the proper design and of sufficient size so that water enters at a point well inside the mixer and charging is completed within the first 25 % of the mixing time.
2. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.
3. Admixtures shall be charged to the mixer in accordance with the instructions of the manufacturer. Automatic dispensers shall be used.
4. The mixing time required shall be based upon the ability of the mixer to produce uniform, homogeneous, consistent mixture throughout the batch and from batch to batch.
5. Final mixing times shall be based on the results of mixer performance tests made at the start of the project and the time fixed unless a change is authorized by the Engineer. The mixing time, however, shall not be less than 45 seconds. Mixing time shall comply with ASTM C 94 sec 11.3.1
6. The mixing time shall be measured from the time all ingredients are in the mixer.
7. The mixer shall be designed for starting and stopping under full load.
8. All structural concrete to be placed in situ shall be manufactured in a computer controlled batching plant
9. Concrete shall be mixed in batches in plant capable of combining the aggregates, cement and water (including admixtures, if any) into a mixture of uniform color and consistency and of discharging the mixture without segregation.
10. Contractor shall make due allowance for the water contained in the aggregates when determining the quantity of water to be added to each mix. The amount of water added to each mix shall be adjusted to maintain the constant approved water-cementitious ratio of the mixed concrete.
11. No concrete shall exceed the water-cementitious ratio as given in Table 4. Excess water over the maximum allowed by the mix design shall not be permitted, and any batch containing such excess will be rejected.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****R. Ready-mixed Concrete**

1. Concrete from approved suppliers of ready mixed concrete with proven record, shall be used in the Works after satisfying all the requirements of these specifications and ASTM C 94, "Standard Specification for Ready-Mixed Concrete".
2. The Contractor shall satisfy the Engineer on the following:
 - a. Materials used in ready-mixed concrete comply with the specification in all aspects.
 - b. Manufacturing and delivery resources of the proposed supplier are adequate to ensure proper and timely completion of pouring schedules.
3. The specified requirements as to the sampling, trial mixing, testing and quality of concrete, of various classes as described in Parts 1.9 to 1.012 of this Specification, shall apply equally to ready-mixed concrete.
4. Every additional facility, including but not limited to testing equipment, labor, laboratory facilities and transport, which the Engineer or persons authorized by him may require for the supervision and inspection of the batching, mixing, testing and transporting to Site of ready mixed concrete shall be provided by the Contractor at no extra cost.
5. Prior to commencement of the works the Contractor shall furnish the following details to the Engineer in addition to ensuring that the concrete from the selected source will be satisfying all the requirements stated in the relevant clauses.
 - a. Name and qualification of supplier(s).
 - b. Location of the supplier(s) plant and travel time to the site.
 - c. Certificate of quality assurance.
 - d. Quality control facilities.
 - e. Historical certificates and test reports on concrete production.
 - f. Source(s) of aggregates, cement, water, and mineral and chemical admixtures
 - g. Test certificates for all concrete ingredients
 - h. Production capacities.
 - i. Results of trial mixes
 - j. C.V. of personnel year-marked for the projects. Approved personnel shall not be changed without prior approval of the Engineer.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****S. Ready-mixed Concrete (Cont'd)**

6. Ready mixed concrete, mixed off site shall be transported in approved truck mixers or agitators and shall be accompanied by a computer printout. Copies of all delivery notes shall be submitted to the Engineer in duplicate, on computer generated forms and shall include at least the following information.
 - a. Name of supplier, serial number of ticket and date
 - b. Truck number
 - c. Name of Contractor
 - d. Name and location of project
 - e. Class of concrete
 - f. Specified slump
 - g. Type and source of cement
 - h. Source of aggregates
 - i. Nominal maximum size of aggregate
 - j. Quantity of each concrete ingredient (SSD and Batch weights)
 - k. Type of admixture and quantity
 - l. Water content
 - m. Times of loading and departure from ready-mix plant
 - n. Notations to indicate equipment was checked and found to be free of contaminants prior to batching.
7. A copy of the delivery note shall be given to the Engineer's site representative for each load.
8. Unless approved otherwise in advance of batching, all concrete of single design mix for any one day's pour shall be from a single batch plant of a single supplier.
9. Central-mixed concrete shall be thoroughly mixed in a stationary mixer and shall be then delivered using a truck agitator. ASTM C 94 limits the volume of concrete charged into the truck to 80% of the drum or truck volume. When partially mixed concrete, with final mixing and transporting being done in a revolving-drum truck mixer, the volume of concrete charged into the truck is limited to 63% of the drum volume as stated in ASTM C 94.
10. The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer.
11. Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight, and so constructed that the concrete can be conveyed and discharged into the pumps at site maintaining the uniform distribution of materials throughout the mass.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****R. Ready-mixed Concrete (Cont'd)**

12. Before discharge of concrete transported in truck mixers, the drum shall again be rotated at mixing speed for about 30 revolutions to re-blend possible stagnant spots near the discharge end into the batch.
13. Mixers shall be properly maintained to prevent mortar and dry material leakage. Inner mixer surfaces shall be kept clean and worn blades shall be replaced. Mixers not meeting the performance tests referenced in ASTM C 94 shall be taken out of service until necessary maintenance and repair corrects their deficient performance.
14. Concrete, after being discharged from the mixer, shall be transported as rapidly as possible to its final position in the works by means that shall be approved by the Engineer, and which shall prevent adulteration, segregation, loss or contamination of the ingredients.
15. The concrete shall be placed and compacted in its final position within 90 minutes of the water being added to the mix. However, this time of 90 minutes may be increased with the use of approved retarding admixtures at the discretion and approval of the Engineer, depending on the necessity and circumstances. On no account shall additional water be added nor is further mixing permitted.
16. The containers that convey the concrete shall at all times be kept clean and free from hardened or partially hardened concrete.
17. The use of chutes, spouts, or piped pumping shall be permitted only with the written approval of the Engineer.
18. If the Contractor proposes the use of piped pumping for the transporting and placing of concrete, he shall submit a method statement indicating full details of the equipment and operating system for the approval of the Engineer. On approval, the Contractor shall ensure that shocks shall not be transferred from the pipeline to the formwork, previously laid concrete, or the structure.
19. The initial discharge of any pumped concrete shall be discarded and not be incorporated in the permanent works.
20. When concrete is conveyed by chutes or pipes, the size and design of the chutes and pipes shall be so selected to ensure continuous flow. The slope of the chute or the pressure of the pump shall allow the concrete to flow without the use of any water additional to that approved by the Engineer to produce the required consistency and without causing segregation of the ingredients. The delivery end of the chute or pipe shall be as close as possible to the final point of deposit.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****R. Ready-mixed Concrete (Cont'd)**

21. The chute or pipe shall be thoroughly flushed with water before and after each working period and shall be kept clean. The water used for this purpose shall be discharged outside and away from any permanent works.
22. Mixing at a central plant shall conform to the applicable requirements of the Standard Specification for Ready-Mixed Concrete of ASTM: C 94 and this Specification.
23. The mixing machines (scales/meters, etc...) shall be tested and calibrated for their accuracy by a specialist at regular intervals of at least six months or such periods as approved by the Engineer. Relevant certificates shall be submitted to the Engineer before the commencement of works and after each test or calibration.
24. The weights of fine and coarse aggregates shall be adjusted to allow for any free water contained in them. Accordingly the amount of water to be added shall be reduced by this amount of free water contained in the aggregates. The Engineer shall be provided access to verify that the method of determining the free water content was followed immediately before mixing begins each day and further during the day as the Engineer desires.
25. The Concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial setting shall not be used. Concrete, which has partially hardened, shall not acceptable for placing..

S. Handling and Placing Concrete**1. General**

- a. Prior to pouring concrete in any structure, the Contractor shall secure a written order to commence from the Engineer.
- b. Concrete shall only be placed after the Engineer has inspected and approved the foundation, construction joints, cleanliness, alignment and suitability of forms, water stops, reinforcement, and any other embedments in the placement.
- c. All of these features shall be carefully examined to make sure they are in accordance with the drawings, specifications, and good practice.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

S. Handling and Placing Concrete (Cont'd)

2. Planning and Preparation before Placing
 - a. Advance planning shall ensure an adequate and consistent supply of concrete.
 - b. Sufficient placement capacity shall be provided so that the concrete can be kept plastic and free of cold joints while it is being placed.
 - c. All placement equipment shall be clean and in good working condition. Standby equipment shall be available if an interruption in the concreting process occurs.
 - d. The placement equipment shall be arranged to deliver the concrete to its final position without significant segregation and they shall be adequately and properly arranged so that placing can proceed without undue delays.
 - e. Manpower shall be sufficient to ensure the proper placing, consolidating, and finishing of the concrete. The concrete shall be delivered to the site at a uniform rate compatible with the manpower and equipment being used in the placing and finishing processes.
 - f. If the concrete is to be placed at night, the lighting system shall be sufficient to illuminate the inside of the forms and to provide a safe work area.
 - g. Forms shall be accurately set, clean, tight, adequately braced, and constructed of or lined with materials that will impart the desired off-the-form finish to the hardened concrete. Wood forms, shall be oiled or treated with a form-release agent, before placing concrete. Forms shall be made for removal with minimum damage to the concrete.
 - h. Reinforcing steel shall be clean and free of loose rust or mill scale when concrete is placed. Mortar splattered on reinforcing bars from previous placements need not be removed from steel and other embedded items if the next lift is to be completed within a few hours; loose, dried mortar, however, must be removed from items that will be encased by later lifts of concrete. Care shall be taken to ensure that all reinforcing steel is of the proper size and length and that it is placed in the correct position and spliced in accordance with the plans. Adequate concrete cover of the reinforcing steel has to be maintained. Bars and embedded items shall be held securely in the proper position by suitable supports and ties to prevent displacement during concreting.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****S. Handling and Placing Concrete (Cont'd)****3. Placing of Concrete**

- a. Arrange equipment so that the concrete has an unrestricted vertical drop to the point of placement or into the container receiving it. Concrete shall not be allowed to drop freely from a height of more than 1.5 m.
- b. To avoid segregation, concrete shall be deposited continuously as near as possible to its final position and shall not be moved horizontally over a too long distance as it is being placed in forms or slabs.
- c. In slab construction, placing shall be started along the perimeter at one end of the work with each batch discharged against previously placed concrete. The concrete shall not be dumped in separate piles and then leveled and worked together; nor shall the concrete be deposited in large piles and moved horizontally into final position.
- d. In walls and columns, concrete shall be placed in horizontal layers of uniform thickness; each layer shall be thoroughly consolidated before the next layer is placed. The rate of placement shall be rapid enough so that previously placed concrete has not yet set when the next layer of concrete is placed upon it in order to prevent flow lines, seams, and planes of weakness (cold joints). Layers shall be about 150 to 500 mm thick for the reinforced concrete members unless otherwise directed by the Engineer.
- e. In raft foundation, the step method of placement shall be used where large areas are involved to avoid the occurrence of cold joints. In this method, the lift is built up in a series of horizontal, stepped layers 300 to 450 mm thick. Concrete placement on each layer shall extend for the full width of the raft, and the placement shall progress from one end of the lift toward the other, exposing only small areas of concrete at a time. As the placement progresses, part of the lift will be completed while concreting continues on the remainder.
- f. In monolithic placement of deep beams, walls, or columns, to avoid cracks between structural elements, concrete placement shall stop for a short period to allow settlement of the deep element before concreting is continued in any slabs, beams, or girders framing into them. The delay shall be short enough to allow the next layer of concrete to knit with the previous layer by vibration, thus preventing cold joints and honeycombing.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

S. Handling and Placing Concrete (Cont'd)

3. Placing of Concrete (Cont'd)

g. In case of occurrence of cold joints, the contractor shall submit a method statement for the remedy of the situation to the Engineer for his approval.

h. Slab on Grade

a. Reinforced concrete must not be placed directly upon the ground; it shall be placed on a layer of blinding concrete not less than 75 mm as indicated in the drawings.

b. The subgrade on which a slab on ground is to be placed shall be well drained, of uniform bearing capacity, level or properly sloped, compacted to maximum density, and free of sod, organic matter, and frost.

c. The subgrade and subbase layers shall be moistened with water in advance of placing concrete.

d. A vapor retarder (polyethylene film) shall cover the subbase below the slab on ground. It shall be 0.15 to 0.25 mm polyethylene film and shall be overlapped at 150 mm at the edges.

e. The concrete used for the slab on ground shall be of controlled bleeding rate to avoid cracking of the concrete surface.

4. Equipment

a. Types of equipment such as buckets and pumps may be used in placing of concrete. This equipment shall be able to place the concrete in the correct location without compromising its quality.

5. Placing on Hardened Concrete

a. When freshly mixed concrete is placed in contact with existing hardened concrete, a high quality bond and watertight joint are required.

b. The surface of old concrete upon which fresh concrete is to be placed must be thoroughly roughened and cleaned of all dust, surface films, deposits, loose particles, grease, oil, and other foreign material. Recently hardened concrete may only require stiff-wire brushing.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****S. Handling and Placing Concrete (Cont'd)**

6. Great care shall be taken to prevent sand or other foreign matter from being introduced into the concrete from the workmen's boots or any other source. Structural concreting against open excavations as a back shutter will not be permitted unless approved by the Engineer.

Consolidation

1. Fresh concrete shall be consolidated by mechanical vibration to mold concrete within the forms and around embedded items and reinforcement; and to eliminate stone pockets, honeycomb, and entrapped air.
2. Vibration shall not remove significant amounts of intentionally entrained air in air-entrained concrete.
3. Unless otherwise directed by the engineer, internal vibrators shall be used to consolidate concrete in footings, walls, columns, beams, and slabs.
4. Vibrators shall not be used to move concrete horizontally.
5. Whenever possible, the vibrator shall be lowered vertically into the concrete at regularly spaced intervals and allowed to descend by gravity. It shall penetrate to the bottom of the layer being placed and at least 150 mm into any previously placed layer. The height of each layer or lift shall be about the length of the vibrator head or generally a maximum of 500 mm in regular formwork.
6. In thin slabs, the vibrator shall be inserted at an angle or horizontally in order to keep the vibrator head completely immersed. However, the vibrator shall not be dragged around randomly in the slab.
7. The distance between insertions shall be about one and a half times the radius of action so that the area visibly affected by the vibrator overlaps the adjacent previously vibrated area by a few centimeters.
8. The vibrator shall be held stationary until adequate consolidation is attained and then slowly withdrawn. The length of time that a vibrator shall be left in the concrete will depend on the workability of the concrete, the power of the vibrator, and the nature of the section being consolidated, but shall not, under any circumstance, exceed 15 seconds in the same location. Specifications and applications of internal vibrators shall follow in the guidelines of ACI 309 "Guide for Consolidation of Concrete" Table 5.1.5.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****S. Handling and Placing Concrete (Cont'd)****Consolidation (Cont'd)**

9. Vibrators shall not be used in such a way as to damage formwork, other parts of the works, or displace the reinforcement. For slabs on grade, the vibrator shall not make contact with the sub-grade.
10. In heavily-reinforced sections where an internal vibrator cannot be inserted, rebar shakers could be used to vibrate the reinforcing bars at their exposed portions, unless otherwise specified by the Engineer.
11. External vibrators shall not be used except with the approval of the Engineer.
12. Under-vibration and/or over-vibration shall be avoided to prevent the occurrence of defects such as honeycombs, excessive amount of entrapped air voids, sand streaks, cold joints, loss of entrained air in air-entrained concrete, and excessive form deflections.
13. Standby vibrators shall be on hand at all times in the event of a mechanical breakdown.

T. Hot Weather Concreting

In hot weather, the fresh concrete temperature at placing shall not exceed 35 °C (for thin slabs, walls, columns, and beams) and the differential temperature between any two points in hardened concrete shall not exceed 30 °C for concrete made with Limestone, and 20 °C for concrete made with other types of aggregates.

In addition, the following measures shall be taken to counter the effects of high concrete temperature in hot weather:

1. Forms, reinforcing steel, and subgrade shall be fogged or sprinkled with cool water just before the concrete is placed.
2. Concrete shall be placed as close as possible to its final position.
3. The concrete consistency shall allow rapid placement and consolidation.
4. Slump loss of freshly mixed concrete shall be controlled as much as possible to minimize the need for retempering of concrete on site.
5. Time of transport, placing and finishing shall be reduced to a minimum.
6. Sufficient labor and equipment must be available at the jobsite to handle and place concrete immediately upon delivery.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****T. Hot Weather Concreting (Cont'd)***

7. Initial setting time of the fresh concrete shall be controlled and the concrete shall remain plastic long enough so that each layer can be placed without development of cold joints or discontinuities in the concrete. The concrete layers shall be shallow enough to assure vibration well into the layer below and that the elapsed time between layers is minimized. The use of the appropriate retarding admixtures will be beneficial in offsetting the accelerating effects of high concrete temperature.
8. Methods to limit moisture loss during placing and finishing shall be considered in order to prevent plastic shrinkage cracks especially in flatwork. Such methods include erecting windbreaks and sunshades, fogging or spraying. The contractor may schedule concrete placements in the evening, in the early morning or at night after the consent of the Engineer.
9. Finishing operations and their timing shall be guided only by the readiness of the concrete for them.
10. Curing shall be conducted so that at no time during the prescribed period will the concrete lack ample moisture and temperature control to permit full development of its potential strength and durability.
11. Thermal cracking shall be avoided by limiting the maximum hardened concrete temperature to 80 °C at any time.
12. In case of air entrained concrete, an increase in the amount of air-entraining admixture is required to maintain the desired air content.
13. Ice can be used as a part of the mixing water to cool the concrete, but it shall be crushed, shaved, or chipped when placed directly into the mixer. It must melt completely prior to the completion of mixing of the concrete. Its quantity shall not exceed 75% of the batch water requirement.
14. A preconstruction meeting shall be organized to discuss the precautions required for pouring in hot weather.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

U. **Retempering**

1. Water addition to the fresh concrete on site to compensate for the loss of workability is prohibited under all circumstances.
2. Retempering by the use of high range water reducers is allowed only once and after the contractor submits to the Engineer, the necessary documents indicating the type, compatibility and the maximum allowed dose of the admixture.

V. **Damaged Work**

1. Should any concrete be damaged through negligence in taking the foregoing precautions, or for any other negligence on the part of the Contractor; the Engineer may, at his discretion, require the damaged work to be removed and reinstated by the Contractor at his own expense.

W. **Reinforcement**

1. Submittal
 - a. Product data including the manufacturer's specification and installation instructions for proprietary materials and reinforcement accessories shall be provided.
 - b. The Contractor shall submit the manufacturer's records of chemical and physical properties of each batch of billet steel bars and a certificate that the respective material furnished meets the requirements for the steel reinforcement specified. The manufacturer's records shall include certificates of mill as well as analysis, tensile and bend tests of the reinforcement.
 - c. Three copies of the steel test report shall be furnished with each consignment of steel reinforcement. The steel shall be tagged and cross-referenced with mill certificates.
2. The Contractor shall prepare for his own use bar bending Schedules from the information given on the Drawings and in these Specifications. These schedules shall be submitted to the Engineer for approval, which shall in no way relieve the Contractor of his responsibility for the correctness of these schedules.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

W. **Reinforcement (Cont'd)**

3. All reinforcement shall be placed strictly in accordance with the Drawings and as instructed in writing by the Engineer. Nothing shall be allowed to interfere with the required disposition of the reinforcement, and the Contractor shall ensure that all parts of the reinforcement are placed correctly in position and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place.
4. The ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced. The inside of their curved part shall be in actual contact with the bars, around which they are intended to fit.
5. Delivery storage and handling
 - a. On delivery, bars in each lot shall be legibly tagged by the manufacturer. The tag shall show the manufacturer's test number and lot number and other applicable data that will identify the material with the certificate issued for that lot of steel. The fabricator shall furnish three copies of a certification which shows the batch number or numbers from which each size of bar in the shipment was fabricated.
 - b. Storage of reinforcement shall be on suitable structures a minimum of 450 mm above the ground surface to prevent damage and accumulation of dirt, rust and other deleterious matter. Storage facilities shall be such as to permit easy access for inspection and identification. Reinforcement bundles shall be clearly tagged with bar schedule and bar mark reference.
 - c. The reinforcement shall not be roughly handled, dropped from a height, or subjected to shock loading or mechanical damage. Steel reinforcing bars shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, earth, paint, or any other material which may impair the bond between the concrete and the reinforcement. The reinforcement shall be covered to ensure protection from wind blown dust, condensation, rain and other deleterious materials

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****W. Reinforcement (Cont'd)**

6. Reinforcing Materials

- a. Reinforcing Steel shall conform to the requirements of ASTM A 615.
- b. Reinforcement shall meet the following requirements for minimum yield stress

Bars	Grade	Yield Stress	Symbol
Plain round mild steel	40	280 MPa	Φ
Deformed High Yield bars	60	420 MPa	T

- c. If in the opinion of the Engineer the steel has excessive surface rust, dust or other deleterious material then the steel shall be sand blasted. Sand for blasting shall not contain materials deleterious to the durability of the reinforcement or concrete.
- d. All reinforcement shall be pressure washed with fresh water after erection and immediately before placing concrete.
- e. Tie wire: wire for binding reinforcement bars shall be soft black annealed mild steel wire. The diameter of the wire shall not be less than 16 S.W.G. (1.6mm) and the binding shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inwards.

7. Inspection sampling and testing

- a. Inspection of reinforcing steel and the installation thereof will be conducted by the Engineer.
- b. The Contractor shall give 24 hour notice to the Engineer before closing forms or placing concrete.
- c. The Engineer may instruct the Contractor to break out and remove completely all sections of the work already constructed under any of the following circumstances:
 - i. Reinforcing steel sample under test fails to meet the specification requirements at any time
 - ii. The Engineer considers that samples which were presented to him for test were not truly representative
 - iii. It becomes apparent that reinforcing steel which has not been approved has been used on the Works.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

W. **Reinforcement (Cont'd)**

- d. Representative samples of all reinforcing steel that the Contractor proposes to use in the works must be submitted, before work is commenced, to the Engineer for his written approval.
- e. Manufacturer's certificates stating clearly for each sample:
 - i. Place of manufacture
 - ii. Expected date and size of deliveries to site
 - iii. All relevant details of composition, manufacture, strengths and other qualities of the steel.
- f. The Engineer reserves the right to sample and inspect all reinforcement steel upon its arrival at the work site. Contractor shall provide a certificate confirming that samples taken from the bars delivered to the works pass the re-bend test.
- g. Frequency of sampling and the method of quality control shall be performed from each lot and delivery for each type and bar size. At least two tension tests and one bend test shall be made from each selected bar.
- h. Allow 14 days for Engineer's review of samples.
- i. Testing
 - i. Tests shall be carried out when directed by the Engineer.
 - ii. Tests shall be carried out in accordance with ASTM A 615
 - iii. Tensile tests providing information on following will be required from each delivery of reinforcement:
 - a. Ultimate strength
 - b. Cross-sectional area
 - c. Deformation/bend characteristics of deformed bars.
- j. The Contractor is to provide tensile, bend, rebend and chemical tests at his own expense, for each size of bar to be used in the concrete construction.
- k. Test results for each bar size shall be submitted to the Engineer three weeks before concrete work commences on Site.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

W. Reinforcement (Cont'd)

- l. Full testing shall be required if the source of supply of reinforcement changes, in which case the cost of such extra testing will be borne by the Contractor.
- m. When any test results do not conform to the relevant standard the reinforcement steel shall be removed from the Site and all costs resulting therefrom shall be borne by the Contractor.
- n. Cutting and bending of reinforcement shall be in accordance with ACI 318 and shall be done without the application of heat. Bends shall have a substantially constant curvature.
- o. Reinforcement shall not be straightened or re-bent without the approval of the Engineer. If permission is given to bend projecting reinforcement care shall be taken not to damage the concrete and to ensure that the radius is not less than the minimum specified in ACI 318.
- p. All reinforcement shall be securely and accurately fixed in positions shown on the Drawings to ensure that the reinforcement steel framework as a whole shall retain its shape. The framework shall be so temporarily supported as to retain its correct position in the forms during the process of placing and consolidating the concrete.
- q. No part of the reinforcement shall be used to support access ways, working platform or for the conducting of an electric current
- r. The Contractor's specific attention is drawn to the following general requirements:
 - i. Lapped joints shall be as indicated on the Drawings and/or in accordance with the requirements of ACI codes
 - ii. Hooks shall be semicircular with a straight length as shown in design
- s. Welding shall not be used unless authorized by the Engineer and recommended by the reinforcement manufacturer.
- t. Where welding is approved it shall be executed under controlled conditions in a factory or workshop.
- u. Welding shall not take place on site without the approval of the Engineer and unless suitable safeguards and techniques are employed and the types of steel employed have the required welding properties.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

W. Reinforcement (Cont'd)

- v. Mechanical splices shall comply with ACI 318, and shall be used as and where indicated on the Drawings. Details of mechanical splices shall be submitted to the Engineer for approval.
- w. Bundling and splicing of bundled bars shall be in accordance with ACI 318. Splicing, except where indicated on the Drawings or approved shop drawings, will not be permitted without the approval of the Engineer.
- x. The Contractor shall notify the Engineer at least 24 hours before commencing the fixing of reinforcement in order to facilitate the inspection of formwork. The Contractor shall ensure that areas to receive reinforcement are cleaned before fixing.
- y. Reinforcement shall not be fixed or placed in contact with non-ferrous metals
- z. Concrete cover
 - i. Correct concrete cover to reinforcement shall be maintained with the aid of approved spacer pieces
 - ii. The cover shall not be less than as given in the drawing.
- aa. Spacers, chairs and other supports shall be provided as necessary to maintain the reinforcement in its correct position. In a member where the nominal cover is dimensioned to the links, spacers between the links and formwork shall be the same dimension as the nominal cover.
- bb. Spacer bars shall be of the same diameter as longitudinal bars, but not less than 25 mm in diameter, and shall be fixed between two layers at 1.5 m centers except where bundled bars are detailed.
- cc. Spacers, chairs and other supports shall be made of concrete, plastic or other material to the approval of the Engineer. Where supports are made of concrete they shall have at least the same strength as the concrete in the host member.
- dd. Placing of all reinforcement steel bars will be checked by the Engineer and in no case is concrete to be placed around any reinforcement steel that has not been approved by the Engineer. Insertion of bars into or the removal of bars from concrete already placed shall not be permitted.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

W. Reinforcement (Cont'd)

- ee. Reinforcement steel temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Engineer.
- ff. The position of reinforcement before and during placing concrete shall be checked
- gg. Particular attention shall be paid to the position of top reinforcement in cantilever sections
- hh. Reinforcement shall be clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances which may adversely affect reinforcement, concrete, or the bond between the two.
- ii. Projecting reinforcement from the weather where rust staining of exposed concrete surfaces may occur shall be protected at all times.
- jj. At the time of concreting, all reinforcement steel shall have been thoroughly cleaned and freed from all mud, oil or any other coatings that might destroy or reduce the bond and the following measures applied:
 - i. Cleaning all set or partially set concrete which may have been deposited thereon during the placing of a previous lift of concrete
 - ii. All uncoated rust bars shall be again sand blasted and pressure washed.. Immediately before concrete placing the reinforcing steel shall be washed thoroughly with high pressure potable water jets to remove any deposited salts.

X. Curing and Protection

1. The method, procedure, materials, and equipment for curing shall be submitted to the Engineer for approval.
2. Chemical curing compounds when used shall be stored in accordance with manufacturer's recommendations.
3. The Contractor shall ensure that curing is provided for 24 hours per day including holidays and that all related necessary plant and labor resources are also available.
4. Special attention shall be given to the curing of vertical and overhanging surfaces to ensure satisfactory curing.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

X. Curing and Protection (Cont'd)

5. The Contractor shall adopt curing measures that preclude the possibility of thermal shock to the concrete during curing. This may be achieved by ensuring that the temperature of the water used for curing does not differ from that of the concrete by more than 15 °C.
6. Water used for any curing purposes shall conform to the requirements of water used in concrete
7. All concrete shall be cured for a period of time required to obtain the full specified strength, but not less than seven consecutive days. The method of curing shall be by water for the first seven days and by water or membrane until the concrete has reached the full specified strength.
8. Exposed surfaces shall be protected from air blown contamination until 28 days after the concrete is placed.
9. The method of curing shall ensure that sufficient moisture is present to complete the hydration of the cement, and shall be to subject the approval of the Engineer. The method of curing shall not :
 - a. Disfigure permanently exposed surfaces
 - b. Affect bonding of subsequent coatings
 - c. Increase the temperature of the concrete.
10. Curing of formed surface
 - a. Formed surfaces, including the underside of beams, supported slabs and the like, by moist curing with the forms in place for the full curing period, or until the forms are removed.
 - b. When the forms are stripped, curing shall continue by any approved method.
 - c. Air barriers shall be constructed at each slab to prevent plastic shrinkage cracks
 - d. Curing of Raft Foundation
 - e. The contractor shall submit curing methodology and measures to be taken on site to cope with the generation of heat from hydration of cement and attendant volume change to minimize cracking. The method shall address but not be limited to the following points:
 - i. Maximum placing temperatures
 - ii. Maximum temperature achieved within the section

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****X. Curing and Protection (Cont'd)**

- iii. Maximum differential temperature between centre and surface of the section
- iv. Maximum temperature difference between the centre of the pour and ambient temperature
- v. Maximum differential temperature between successive pours or lifts
- vi. In case of casting against existing concrete, the difference between the mean temperatures in the existing and the newly cast sections shall be taken into consideration
- vii. The rate of evaporation shall not approach 1 Kg/m²/hr and precautions against plastic shrinkage cracking shall be listed
- f. The curing methodology shall be submitted to the Engineer for approval
- g. The concrete temperature shall be monitored over a 7 days period to check the specified temperatures in the concrete structure and monitor the effectiveness of the application of the direct curing and insulating treatment
- h. The Contractor shall organize a pre-pouring meeting and discuss site preparations. Site preparations shall be approved by the Engineer.
- i. Differential temperature shall not exceed 30oC for concrete made with limestone and 20oC for concrete made with other sources of aggregates.
- j. The Contractor shall submit a summary report of concrete temperature recorded within the 7 days period detailing all steps and measures taken to the Engineer.

11. Curing of unformed surface

Unformed surfaces shall be protected as soon as possible after the concrete has been placed by polythene sheeting. When sufficiently hard, hessian or other absorbent material shall be placed on the concrete surface and shall be kept wet for the required period. The Hessian shall be overlaid with polythene sheet to assist in the retention of water. Alternatively a curing method approved by the Engineer may be used.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

X. **Curing and Protection (Cont'd)**

12. Moisture curing shall be performed by :

- a. Covering the surface of the concrete with water and keeping it continuously wet
- b. Continuous use of fine fog water sprays
- c. Covering the surface with a saturated absorptive cover and keeping it continuously wet.

Where the method referenced in section 1.15.L.1 is used; the bunds shall not be made of fill from excavations or any other areas where there is a possibility of chloride contamination.

13. The moisture retaining curing cover shall be in the widest practical widths and shall have 200 mm side and end laps. The laps shall be sealed with adhesive tape. Any penetrations or tear in the covering shall be repaired with the same material and waterproof tape

14. Unhardened concrete shall be protected from heavy rains or flowing mechanical injury and the Contractor shall submit for the Engineer's approval his construction procedure which is designed to avoid such an event. No fire, excessive heat or carbon oxide gases shall be permitted near or in direct contact with concrete at any time.

15. Liquid membrane curing

- a. Curing media shall meet all requirements of the "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete" of ASTM C 309 and "Test for Water Retention by Concrete Curing Materials" of ASTM C 156.
- b. Membrane forming curing compounds shall be applied in accordance with the manufacturer's recommendations immediately after any water sheen which may develop after finishing has disappeared from the surface and within 2 hours of stripping formwork on formed surfaces
- c. Membrane forming curing compounds shall not be used on surfaces against which additional concrete or other material is to be bonded unless:
 - i. It is proven that the curing compound will not prevent bond, or
 - ii. Positive measures are taken to remove it completely from those areas which are to receive bonded applications
 - iii. It is used on fair faced concrete surfaces.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****Y. Construction Joints**

1. All construction joints either shown on the drawings or proposed by the Contractor shall be clearly detailed on shop drawings and submitted to the Engineer for prior approval before commencing work. However approval accorded by the Engineer shall not relieve the Contractor of any of his obligations under the contract.
2. When construction joints necessitate the provision of water bars the same shall be indicated by the Engineer on the drawings submitted by the Contractor who shall provide and install the same at no extra cost to the project in accordance with the manufacturer's instructions.
3. Beams, girders, haunches, drop panels and capitals shall be placed monolithically as part of the slab system, unless otherwise shown in design drawings or specification. No construction joints shall be permitted in respect of the above.
4. Vertical joints shall be formed by means of rigid stopends, and all horizontal joints shall be level.
5. The surfaces of all joints shall be thoroughly roughened, cleaned of all loose and foreign matter and laitance, and washed with water. Just before concreting is resumed, the joint shall be treated with either a thin layer of neat cement grout or a sand and cement grout mixed in the same proportions as the sand and cement in the concrete. This grout shall be worked well into the surface of the concrete. When indicated on drawings the surfaces of joints shall be treated with an approved epoxy bonding agent to the extents shown therein. The bonding agent shall be applied as recommended by the manufacturer.
6. All slabs on grade shall have control joints as directed by the Engineer.

Z. Execution**1. Formwork**

Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****Z. Execution (Cont'd)****1. Formwork (Cont'd)**

Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

- i. Class A, (3.2 mm) for smooth-formed finished surfaces.
- ii. Class B, (6 mm) for rough-formed finished surfaces.

Construct forms tight enough to prevent loss of concrete mortar.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

- i. Install keyways, reglets, recesses, and the like, for easy removal.
- ii. Do not use rust-stained steel form-facing material.

Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

Chamfer exterior corners and edges of permanently exposed concrete.

Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****AA. Embedded Items**

Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

- a. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- b. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
- c. Install dovetail anchor slots in concrete structures as indicated.

BB. Removing and Reusing Forms

General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

- Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
- Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****DD. Shores and Reshores***

Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

- Do not remove shoring or reshoring until measurement of slab tolerances is complete.

In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

EE. Vapor Retarders

Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

- Lap joints (150 mm) and seal with manufacturer's recommended tape.

Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus (0 mm) or minus (19 mm).

- Place and compact a (13-mm-) thick layer of fine-graded granular material over granular fill.

FF. Steel Reinforcement

General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement. Deformed high tensile bars shall comply with ASTM A615 M yield strength F_y minimum 425 N/mm².

- Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****FF. Steel Reinforcement (Cont'd)**

- Weld reinforcing bars according to AWS D1.4, where indicated.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

GG. Joints

General: Construct joints true to line with faces perpendicular to surface plane of concrete.

Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

- Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
- Form keyed joints as indicated. Embed keys at least (38 mm) into concrete.
- Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
- Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****GG. Joints (Cont'd)**

- Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
- Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

- Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
- Terminate full-width joint-filler strips not less than (13 mm) or more than (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
- Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

HH. Waterstops

Waterstops: Provide waterstops in construction joints between raft foundation and basement walls, and between water tank slab and walls and in vertical construction joints between walls, or elsewhere indicated by the Engineer.

The Contractor shall provide clean and dust-free surface of application for the bentonite-based waterstop.

Bentonite-based waterstops shall be fixed to the hardened concrete, through the use of steel bolts, as directed by the manufacturer.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****HH. Waterstops (Cont'd)**

Waterstops shall be bentonite based, type Bentorub+ or similar, and possess the technical properties hereunder:-

- Swelling capacity in contact with water	400% of original dry volume
- Density	$\approx 1.45 \text{ kg/dm}^3$
- Weight	$\approx 0.72 \text{ kg/m}$
- Expansion pressure under complete enclosure	$\geq 0.70 \text{ N/mm}^2$
- Resistance against hydrostatic pressure	= 8 bars
- Elongation at rupture	7500%

Other expandable waterstops may be submitted for use, to the Engineer's approval.

In case of use of a bonding agent at the construction joints, with the use of a bentonite-based waterstop, the bonding agent shall be of cement-base type.

II. Concrete Placement

Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

- Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
- Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****II. Concrete Placement (Cont'd)**

- Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

- Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- Maintain reinforcement in position on chairs during concrete placement.
- Screed slab surfaces with a straightedge and strike off to correct elevations.
- Slope surfaces uniformly to drains where required.
- Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

Hot-Weather Placement: Comply with ACI 301 and as follows:

- Maintain concrete temperature below (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
- Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****JJ. Finishing Formed Surfaces***

Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

- Apply to concrete surfaces not exposed to public view.

Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

-Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

- Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****KK. Finishing Floors and Slabs***

General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.

- Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

- Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

- Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
- Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - i. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - ii. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - iii. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - iv. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****KK. Finishing Floors and Slabs (Cont'd)***

- Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed (6 mm), (4.8 mm), (3.2 mm)

Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

- Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

- Uniformly apply dry-shake floor hardener at a rate recommended by manufacturer.
- Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
- After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

LL. Miscellaneous Concrete Items

Filling In: Fill in holes, *openings*, and *tie rods holes left in concrete structures with non shrink grout approved by the Engineer*, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)****MM. Concrete Protecting and Curing**

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

Cure concrete according to ACI 308.1, by one or a combination of the following methods:

- Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - i. Water.
 - ii. Continuous water-fog spray.
 - iii. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with (300-mm) lap over adjacent absorptive covers.

- Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - i. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - ii. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - iii. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

CAST-IN-PLACE CONCRETE (03300) (CONT'D)**PART 2 - PRODUCTS (CONT'D)*****MM. Concrete Protecting and Curing (Cont'd)***

- Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- i. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

NN. Joint Filling

Prepare, clean, and install joint filler according to manufacturer's written instructions.

- Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening. Expansion joints filler in structural concrete shall be fire resistant and filled with:

1. Compressible filler board consisting of wood fibres impregnated with bitumen emulsion.
2. Compressible closed cell expanded polyethylene or polyurethane sheet.

CAST-IN-PLACE CONCRETE (03300) (CONT'D)

PART 2 - PRODUCTS (CONT'D)

OO. **Field Quality Control**

Testing and Inspecting: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

Inspections:

- Steel reinforcement placement.
- Steel reinforcement welding.
- Headed bolts and studs.
- Verification of use of required design mixture.
- Concrete placement, including conveying and depositing.
- Curing procedures and maintenance of curing temperature.
- Verification of concrete strength before removal of shores and forms from beams and slabs.

Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

BEDS AND SCREEDS (03500)

A. **Scope**

1. Screeds are to be the depths, thickness and location shown on the drawings.
2. Finish of the screeds shall be as indicated on 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.

In General all materials specifications and applicable standards mentioned in section 03300 apply to this section, as appropriate.

C. **Related Items**

01300 Submittals
03300 Cast in Place Concrete

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.

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.

Submit samples of colouring additives for by the Engineer before ordering of materials.

4. **Sample of Screed**

Prepare specimens of the mixes and finishes 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 Type I.

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. **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.

6. **Additives**

Waterproofing additive materials for screed in planters, pond, and landscaped area shall be an integral waterproof polymer manufactured for use as admixture and shall be approved by the Engineer.

Additives for other screed 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.

7. **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.

BEDS AND SCREEDS (03500) (CONT'D)

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

8. **Bonder**

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

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.

10. **Reinforcement**

Screed greater than 80mm thick shall be reinforced to the approval of the Engineer.

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.

BEDS AND SCREEDS (03500) (CONT'D)

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

5. **Unbonded Screeds**

Lay polythene sheet on the base and lap all joints not less than 50mm.

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. In any case it shall not exceed 40% of cement weight.

7. **Laying**

The screed shall be laid and trowelled 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 meters, 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.

BEDS AND SCREEDS (03500) (CONT'D)

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

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 wet hethien and keep it so covered and constantly wet 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.

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 40mm.

12. **Finishings**

Screed shall be trowelled smooth or stamped concrete ("Topcrete" or approved equal and with better performance) as indicated on the drawings.

DIVISION 4

MASONRY

DIVISION 4

MASONRY

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MASONRY MORTAR (04100)

A. **Scope**

1. This Section specifies the constituent materials, mixing, handling and testing of mortars for use with precast concrete block work.
2. Procedures for the use of mortars with precast concrete block work are specified in Section 04220.
3. Procedures for the use of mortars with wet fixed stone and for stone flooring are specified in Section 04400.

B. **Performance and Standards**

1. **Performance**

Sampling and testing of mortar mixes shall also be carried out to ensure compliance with the requirements of standards stated below.

2. **Standards**

- a. ASTM C5 - Quicklime for Structural Purposes.
- b. ASTM C91 - Masonry Cement.
- c. ASTM C143 - Slump of Hydraulic Cement Concrete.
- d. ASTM C144 - Aggregate for Masonry Mortar.
- e. ASTM C150 - Portland Cement.
- f. ASTM C199 - Test Method for Pier Test for Refractory Mortar.
- g. ASTM C207 - Hydrated Lime for Masonry Purposes.
- h. ASTM C270 - Mortar for Unit Masonry.
- i. ASTM C387 - Packaged, Dry, Combined Materials for Mortar and Concrete.
- j. ASTM C404 - Aggregates for Masonry Grout.
- k. ASTM C476 - Grout for Masonry.
- l. ASTM C595 - Blended Hydraulic Cements.
- m. ASTM C780 - Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- n. ASTM C1019 - Method of Sampling and Testing Grout.
- o. ASTM C1142 - Extended Life Mortar for Unit Masonry.
- p. ASTM C1329 - Mortar Cement.
- q. ASTM C1357 - Methods for Evaluating Masonry Bond Strength.

C. **Related Items**

04220 Concrete Unit Masonry
04400 Stone

MASONRY MORTAR (04100) (CONT'D)

E. **Product Handling (Cont'd)**

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

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.

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.

MASONRY MORTAR (04100) (CONT'D)

F. Materials

1. Cement

The cement used in mortars shall be Portland cement to ASTM C150 type I, non-staining or BS 12 - Part 2.

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.

6. Plasticizers

Plasticizers shall conform to the requirements of BS 4887, and shall be used only with the written approval of the Engineer. Only plasticizers 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 block work 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 and solid blocks as required for walls and partitions.
2. It shall be noted that architectural masonry drawings shall take precedence and supersede ID masonry 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. 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.

CONCRETE UNIT MASONRY (04220) (CONT'D)

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 Blocks**

The 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 shall be of the following work sizes:

400 x 200 x 80mm
400 x 200 x 100mm
400 x 200 x 150mm
400 x 200 x 200mm

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

Sizes shall conform to the following, unless otherwise specified:

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

Hollow and solid blocks shall be of a minimum compressive strength of 10N/mm² and 15N/mm² of gross area respectively, and the maximum drying shrinkage shall not exceed 0.06%. Hollow blocks facing shall be minimum 30mm thick.

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

CONCRETE UNIT MASONRY (04220) (CONT'D)

F. Materials (Cont'd)

2. Cavity Walls and Walls Built Against Other Construction

The blocks used for cavity and for walls built against other construction 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 of supplying adequate quantities 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

9. Wall Ties

Wall ties used for block to block or block to concrete shall be made of corrosion resistant galvanized 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 "Catnic" or approved equal. Size shall be:

- a. in cavities (if any): 80mm less than the total wall thickness
- b. in tying walls to columns: 200mm.

10. Rockwool Insulation

Cavity walls between apartments shall be filled with rockwool insulation 50mm thick having the following characteristics:-

- a. Standards: Rockwool shall conform to BS EN 13162:2001 'Specification for factory-made mineral wool products'.
- b. Fire Classification: Rockwool shall achieve a reaction to fire classification of A1 as defined in EN 13501-1.
- c. Thermal Performance: Rockwool shall have a thermal conductivity (K value) of 0.037W/mK.
- d. Water Resistance: Rockwool shall ensure that the insulation will stop water crossing the cavity to the inner leaf.
- e. Rockwool shall resist fire spread between and within cavities and shall be non-combustible.
- f. Rockwool shall resist weather and ground moisture and shall not absorb water by capillary action.
- g. Installation shall be as per manufacturer's recommendation, all to the approval of the Engineer.

CONCRETE UNIT MASONRY (04220) (CONT'D)

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

11. **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.

12. **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.

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.

CONCRETE UNIT MASONRY (04220) (CONT'D)

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

1. **Precast Concrete Blockwork (Cont'd)**

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 3m up to and including 6m, plus or minus 15mm.

Over 6m, plus or minus 20mm.

(iii) Straightness

In any 5m (not cumulative), 10mm.

(iv) Vertically

In any 8 courses, plus or minus 5mm.

Blockwalls shall not deviate more than 10mm from the vertical in their full height.

The maximum permitted / acceptable deviation from the required dimension of the block walling shall be as BS 8000: Part 3.

Notwithstanding the provisions of BS 8000 tolerances shall be reduced when, for the purposes of fit and/ or appearance, the tolerances within BS 8000 would fail to meet the design intent and dimensional criteria required by the works.

CONCRETE UNIT MASONRY (04220) (CONT'D)**G. Workmanship (Cont'd)****1. Precast Concrete Blockwork (Cont'd)****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 lintels.

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, lintels, steel plates shall be grouted solidly into masonry work.

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.

CONCRETE UNIT MASONRY (04220) (CONT'D)**G. Workmanship (Cont'd)****1. Precast Concrete Blockwork (Cont'd)****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 *such as electric block cutter*, 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.

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.

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

CONCRETE UNIT MASONRY (04220) (CONT'D)

G. Workmanship (Cont'd)

1. Precast Concrete Blockwork (Cont'd)

p. Cavity Walls and Walls Built Against Other Construction

- 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.

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. 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.

s. Jambs

Concrete jambs shall be provided to sides of openings occurring in blockwalls or partitions. Jambs shall be reinforced and constructed to sizes indicated on drawings.

CONCRETE UNIT MASONRY (04220) (CONT'D)

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

1. **Precast Concrete Blockwork (Cont'd)**

t. **Stiffener Beams and Columns**

Reinforced concrete vertical and horizontal beams and stiffeners shall be provided for blockwalls for seismic considerations.

Horizontal concrete tie beams are required for all masonry walls at 1600mm intervals or as otherwise noted on the Drawings.

Vertical concrete tie beams are required at 3000mm intervals for all masonry walls with length exceeding 6000mm or as otherwise noted on the Drawings.

u. **Intersection with Slabs**

Intersection between walls and slabs shall be constructed as detailed on drawings.

STONE (04400)

A. Scope

1. Provide labour, materials, equipment and services and perform operations required for installation of stone for façade walls, floors, and miscellaneous stone elements, 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. Dry mounted Mounted limestone stone cladding to façade walls, however returns, reveals, heads, jambs, sills, copings, joints, with cement and sand mortar (where required) as indicated on drawing, and miscellaneous stone elements, strips, protruded elements, etc....
 - b. Drilling, fitting and cutting of stone as required for the proper completion of the work of other trades shall be part of this section.
 - c. 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.

STONE (04400) (CONT'D)

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
05010 Metal First Fixing Accessories

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

STONE (04400) (CONT'D)

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 and flooring.
 - 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.

STONE (04400) (CONT'D)

D. Submittals (Cont'd)

4. Job Mockups (Cont'd)

- 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 not 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.
- 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.

STONE (04400) (CONT'D)

E. **Product Handling (Cont'd)**

1. **Stone (Cont'd)**

- 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. Natural Stone**

- a. Stone: shall be stone of type, colour range and finish selected by Engineer 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, bands, joints, cornices, columns, strips, etc... shall be cut to sizes and shaped as detailed on the drawings.
- d. Stone shall be of the following types:
 - Lime stone or approved equal, 30mm thick unless otherwise shown on drawings, cut to size, with brushed finish, for façade cladding to walls, returns, reveals, heads, jambs, sills, copings, joints and for the various stone elements, strips, protruded elements, etc...

2. Characteristics of Stone

- a. The Contractor shall precise the properties of stone depending on the quarry it becomes from. However, the stone shall conform to the following properties and the requirements of ASTM C-503.

Limestone

ASTM Test		Industry Requirement
C97	Absorption, max. (%)	2.0
C97	Density, min., (v.g/m ³)	2500
C99	Modulus of Rupture, min., (psi)	1000
C880	Flexural Strength, min., (psi)	1000
C170	Compressive Strength, min., (mpa)	60
C241	Abrasion Index, min.	10-12
C67	Freeze Thaw Cycle	>300
C217	Weathering (in)	NA

- b. Sizes and thickness of the various stone types and elements shall be as detailed on the drawings and as indicated on Bill Items to the approval of the Engineer.
 - c. Stone 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.
 - d. Inherent variations characteristic of the stone and the quarry from which the stone 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.
 - e. All stone shall be selected for background colour, veining, marking and matching, and shall run in even shades.
3. Mortar Setting Materials where required
- 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)****4. Steel Bars, Strips, Anchors, brackets, and Accessories**

Bars, strips, anchors, angles, brackets and accessories used for mechanically fixed stone shall be fabricated from stainless steel grade 316L. Type and size shall be as indicated and as required to support loading involved, and as indicated on drawings. All stainless steel used shall resist adverse weather conditions.

Stainless steel shall be austenitic, non-magnetic to BS EN 10088 and BS EN 10095, BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259 for plate, sheet and strip, to BS EN 10283 for castings and also to BS 970 and BS EN 10084 where relevant. Stainless steel fasteners, bolts, screws, nuts and other fixings shall be either grade A2 or grade A4 to BS EN ISO 3506: Parts 1 and 2. The property class of fastenings shall be selected to meet the performance requirements as specified.

5. Cleaner

As recommended by stone supplier.

6. Samples at Employer's Offices

The Tenderers shall inspect the various stone and marble samples available at Employer's offices before submitting their Tender, and shall sign on them. The successful Tenderer shall ensure that samples he submits during construction do match with those available at Employer's offices, and / or approved equal and with better performance. Not inspecting these samples shall not relieve the Contractor from his liabilities in this regard, and no claims of whatsoever nature shall be entertained.

8. Adhesive

Tile adhesive shall be as recommended in writing by the manufacturer and applied strictly in accordance with printed recommendations. All tiles to be fixed using adhesive shall be bedded in accordance with the manufacturer's instructions. The adhesive for floor slabs and wall tiles shall be a proprietary adhesive suited to the substrate and stone types. Adhesive shall be compatible with the background/base.

STONE (04400) (CONT'D)

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.
 - 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.

STONE (04400) (CONT'D)

H. Workmanship (Cont'd)

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.

3. Installations, generally

- a. Install the work of this section and fix stone tiles in mortar bed or with mechanical fixations or using adhesive in accordance with drawings, specifications, approved shop drawings industry standards and as required and directed by the Engineer. (In general, façade cladding shall be mechanically fixed; wall tiles in toilets, and all floor tiles shall be fixed using adhesive).
- 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 staged 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. When setting stone, adjacent pieces shall be selected for similarity in colour, veining and matching.

STONE (04400) (CONT'D)

H. Workmanship (Cont'd)

3. Installations, generally (Cont'd)

- a. Joints shall be as shown on drawings and as directed by the Engineer. Joints for stone set in mortar or fixed using adhesive shall be filled with thoroughly ridded to eliminate voids.
- b. Stone shall be set accurately, true to line, plumb and level.
- c. 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.
- d. Partially completed stone work shall be thoroughly covered when work is interrupted to prevent water and moisture from entering behind stone.
- e. Spacing of the horizontal and vertical expansion joints in external stone cladding, shall be as follows:
 - Horizontal joints every 3m
 - Vertical joints every 8m
 - The width of the joints between panels should be at least 5mm

4. Adhesive Fixation

- a. Application: Apply floated coat of adhesive to dry base and comb surface.
- b. Wall surfaces shall be prepared for tiling using a suitable adhesive compound to fill in any excessive indentations prior to applying the suitable adhesive compound.
- c. Tiling: Apply coat of adhesive to backs of tiles filling depressions fully. Press tiles firmly into position and use mechanical fixations if needed for proper installation.
- d. Finished adhesive thickness shall be within range recommended by manufacturer.
- e. In the presence of the Engineer, it shall be verified that there is adhesion over the whole tile area.

STONE (04400) (CONT'D)

H. **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 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.

6. **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

DIVISION 5

METALS

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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
05120 Structural Steel
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.

METAL FIRST FIXING MATERIALS (05010) (CONT'D)

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. **Brass**

Brass shall comply with the requirements of BS 2870 and 2874.

7. **Iron Casting**

Gray iron casting shall conform to ASTM A48, class 30.

Malleable iron castings shall conform to ASTM A47, Grade 32510.

8. **Brackets, Flanges and Anchors**

Brackets, flanges and anchors shall match the supporting rails.

9. **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 shims 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.

METAL FIRST FIXING MATERIALS (05010) (CONT'D)

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.

Stainless steel finish.

Works Priming, epoxy coating, intumescent coating.

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
- 05120 Structural Steel
- 05500 Metal Fabrications

D. Submittals1. 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. The Contractor or the Nominated Subcontractor shall furnish to the Engineer a written guarantee against failure of the finish over a twenty five 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. **Shop Primer for Galvanized Steel**

Zinc dust, zinc oxide primer formulated for priming zinc-coated steel and compatibility with finish paint systems indicated.

4. **Galvanizing repair paint**

High-zinc-dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight complying with DOD-P-21035 or SSPC- paint 20.

5. **Stainless Steel Finish**

Grind and polish surfaces to produce uniform directional textured polished finish, free of cross scratches and blemishes.

METAL FINISHES (05030) (CONT'D)**F. Materials (Cont'd)****6. Anodizing 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. Anodizing 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 anodizing firm and the manufacturer of the articles to be anodized are mutually satisfied on this point. The Engineer shall be informed of the selected process.
- 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.

7. 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-hardinary 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 oven to a temperature of $\pm 190^{\circ}\text{C}$.
- d. The coating thickness shall be 60 microns.

METAL FINISHES (05030) (CONT'D)**F. Materials (Cont'd)****8. Shop Priming of Steel**

- a. All steel items shall be shop primed except where galvanizing is specified.
- b. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- c. Do not prime surfaces in direct contact with concrete or where field welding is required.
- d. The shop primer shall be fast-curing, lead and chromate-free, universal modified-alkyd primer, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated.
- e. Prime paint items with two coats for surfaces which are inaccessible after assembly or erection.
- f. Touch up all primer where damaged during erection.

9. Metal Finishes

- a. Baked-Enamel Finish: Immediately after cleaning and pre-treating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.0254 mm) for topcoat. Comply with paint manufacturer's instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.0508 mm).
- b. Color and Gloss: As indicated by manufacturer's color and gloss designations, (to be approved by the Engineer).

10. Paint

Shop primer for ferrous metal: fast-curing, lead and chromate free, universal modified alkyd primer, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated.

Zinc-Coated Metal: Provide the following finish systems over zinc-coated (galvanized) metal surfaces:

- a. Low-Luster Finish: 2 finish coats over galvanized metal primer (all metal work)

METAL FINISHES (05030) (CONT'D)

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

10. **Paint (Cont'd)**

- b. Primer: Galvanized metal primer and antirust paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.051mm.
- c. First and Second Coats: Low-Luster (eggshell of satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.071mm.
- d. Epoxy:
 - Primer: Epoxy zinc-rich primer, dry film thickness: 75 micrometers
 - Intermediate coat: Epoxy high build, dry film thickness: 125 micrometers.
 - Top coat: Hybrid resin epoxy polyester to provide paint with excellent resistance, light fastness, and heat resistance, dry film thickness: 50 micrometers.
- e. Intumescent Coating:
 - Water-reducible or solvent-reducible, pigmented intumescent paint materials; formulated to retard flame spread and intended for use on interior combustible and non-combustible surfaces.

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.

For metal fabrications exposed to view in the completed work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, rolled marks, rolled trade names, or roughness.

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.

METAL FINISHES (05030) (CONT'D)**G. Workmanship (Cont'd)****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 arises shall be removed. All defects noticed after application of the finish shall be made good.

3. Anodizing

The anodizing 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. All necessary pre-anodic treatments to achieve the required textural finish shall be carried out. The film of anodizing 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 on with the Engineer.

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 including but not limited to the following:

- Stainless steel gratings for ground trenches
- Stainless steel balustrades and handrails
- Stainless steel ladders
- Synthetec premium coated aluminum pergola beams
- Steel staircases
- Miscellaneous steel

B. Performance and Standards

1. ANSI A14.3 - Ladders, Fixed, Safety Requirements.
2. ASTM A36/A36M - Carbon Structural Steel.
3. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
4. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153/A153M - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A283/A283M - Low and Intermediate Tensile Strength Carbon Steel Plates.
7. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A325M - Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric).
10. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
11. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. ASTM B177 - Chromium Electroplating on Steel for Engineering Use.
13. AWS A2.4 (American Welding Society) - Symbols for Welding, Brazing, and Nondestructive Examination.
14. AWS D1.1 (American Welding Society) - Structural Welding Code.

METAL FABRICATIONS (05500) (CONT'D)

C. **Related Items**

- 01300 Submittals
- 05010 Metal First Fixing Materials
- 05030 Metal Finishes
- 05120 Structural Steel
- 08100 Steel Doors
- 08120 Aluminium Doors & Windows
- 09900 Painting

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.

2. **Shop Drawings**

The Contractor shall provide at his own expense all layouts 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 & Synthetic Coating: obtain certification from manufacturer 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.

METAL FABRICATIONS (05500) (CONT'D)

E. **Product Handling (Cont'd)**

1. **Protection and Handling Generally**

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.

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 sections 05010 and 05120, Metal First Fixing Materials and Structural Steel.

2. All metal finishes shall be as set out in section 05030 and 05120, Metal Finishes and Structural Steel.

3. All fabrications shall accord with the Engineer's detailed 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.

METAL FABRICATIONS (05500) (CONT'D)

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

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.

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.

METAL FABRICATIONS (05500) (CONT'D)

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

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.

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, jiggling, 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.

14. Stainless Steel Ladders

- a. Fabricate ladders with dimensions, spacing, details and anchorages as required for the best performance.
- b. Ladders shall be fabricated from stainless steel members grade 316L, including main pipes 30mm diameter with goose neck (where required), and 20mm diameter rungs.
- c. The Contractor shall submit shop drawings for the approval of the Engineer before fabrication.
- d. Fabricate ladders with rungs spaced at 370mm centers and side rails with eased edges. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

METAL FABRICATIONS (05500) (CONT'D)

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

14. **Stainless Steel Ladders (Cont'd)**

- e. Support ladders at top and bottom and at intermediate points spaced not more than 1.2m centres by means of bolted brackets of same material of ladder.
- f. Brackets 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 and not more than 300mm.
- g. Supports, rungs, angles, plates, bolts, anchors and fixing accessories shall be of the same material of the ladder.
- h. Fabricate ladders to dimensions shown on the drawings and indicated in Breakdown of Lump Sum Items.
- j. Stainless steel shall be type 316L to ASTM standards as specified in Section 05010.
- k. Refer to drawing for indication only. Layout shown on drawings shall be the minimum requirements for the materials and workmanship.

15. **Stainless Steel Gratings**

- a. Provide stainless steel grating for trenches, grade 316L, comprising stainless steel angle frame, bearing bars, angles, strap anchors, covered with 100mm x 100mm x 60-65mm thick cobble tiles, with neoprene gaskets and all necessary fixing items and supports to suit trenches where indicated and as per sizes and dimensions indicated on drawings.
- b. Install stainless steel grating and frames true to lines and levels. Ensure that grating is well installed and is non-rocking. 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 Engineer in writing any defects considered detrimental to proper application of grating so defects can be remedied before grating is applied.

METAL FABRICATIONS (05500) (CONT'D)

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

15. **Stainless Steel Gratings (Cont'd)**

- e. Install grating according to manufacturer's recommendations and shop drawings.
- f. All stainless steel shall be type 316L to ASTM standards as specified in Section 05010.
- g. Refer to drawing for indication only. Layout shown on drawings shall be the minimum requirements for the materials and workmanship.
- h. Submit shop drawings to Engineer for approval before fabrication.

16. **Aluminum Pergola Beams**

- a. Fabricate synthetic coated aluminium pergola beams including 400mm x 220mm aluminum plates, M12 expansion bolts, etc... to comply with requirements indicated for design, dimensions, details and members sizes to match the layout as shown on drawings and as indicated in Breakdown of Lump Sum Items. Surface finish of beams shall be durable synthetic powder coated applied by a qualified and approved applicator, such as Synthatec Premium or approved equal and with better performance, all to the approval of the Engineer. The Contractor or the Nominated Subcontractor shall furnish to the Engineer a written guarantee against failure of the finish over a twenty five year period subject to reasonable maintenance by the Employer as recommended by the applicator.
- b. Provide complete framing structure with materials and workmanship in compliance with the design requirements including all necessary supports, fixing accessories and anchorage.
- c. Provide footings, brackets and anchors and securely fix to structural supporting members.
- d. Aluminium and its finish shall comply with the standards detailed in sections 05010, 05030, and 08120.
- e. Submit shop drawings indicating shape, sizes, and details for approval before fabrication.
- f. Refer to drawing for indication only. Layout shown on drawings shall be the minimum requirements for the materials and workmanship.

METAL FABRICATIONS (05500) (CONT'D)

G. Workmanship (Cont'd)

17. Balustrades and Handrails

- a. Fabricate balustrades and handrails in stainless steel comprising stainless steel vertical posts, horizontal balusters, top rail, handrails, etc... to comply with requirements indicated for design, dimensions, details, finish and member sizes, including wall thickness of post, post spacing and anchorage, ports etc. but not less than required to support structural loads and as indicated on drawings.
- b. 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.
- c. For railing posts set in concrete, fabricate sleeves less than 150mm (6 inches) long and with steel plate closure welded to bottom of sleeve.
- d. Brackets, flanges, and anchors shall be formed metal of the same material and finish as supported balusters, unless otherwise indicated.
- e. Stainless steel materials used for balustrades and handrails shall be grade 316L.
- g. Submit shop drawings to Engineer for approval before fabrication.

18. Steel Staircases

- a. Work shall be of the design, shape, 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)

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

18. **Steel Staircases (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 stairs to conform to shape, sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, supports, railings, balusters, steps, struts, clips, brackets, bearing plates and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
- e. Steel members shall receive rust inhibitive coating, prime coat and pneumatic finishing coats of paint as indicated.

19. **Miscellaneous Metal**

- a. Furnish and install steel framing, posts, bracing, brackets, columns, beams, girders, plates, angles, channels, closures, brackets and miscellaneous metal indicated on the drawings or described in this specification.
- b. Miscellaneous metal shall include required support steel for the work of this section, and for the work of other sections.
- c. Metal 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.
- d. Equip units with integrally welded anchors for casting into concrete or building in to 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.

METAL FABRICATIONS (05500) (CONT'D)

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

19. **Miscellaneous Metal (Cont'd)**

- f. Included under this heading of miscellaneous steel are:-
 1. Rails, plates and strips as shown on the drawings.
 2. Angles for framed openings as shown on the drawings.
 3. Elevator tie down and machine beams.
 4. Frames, plates, channels, boxes, etc. shown on drawings.
 5. Ducts and pipe protection.
 6. Aluminium cat ladders and plates in shafts

DIVISION 6

WOOD AND PLASTICS

DIVISION 6

WOOD AND PLASTICS

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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 CP 112, Part 2: 1971, The Structural Use of Timber.

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**

01300 Submittals
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 attack, and warping detrimental to its specified use.

3. **Softwood**

Softwood shall be Douglas Fir, European Redwood, Longleaf pine or other equal approved and with better performance.

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**

01300 Submittals
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 laboratory 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 20-40 Deg. C RH 50

Winter 0-25 Deg. C RH 25

ARCHITECTURAL WOODWORK (06400)

A. **Scope**

1. The extent of Architectural Woodwork is detailed and shown on the drawings and schedules and covers but not limited to:-
 - Cupboards, closets, cabinets, and Vanities
 - Wood decorative panels, cladding, and elements
 - Miscellaneous woodwork as shown on drawings
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.
6. **Decorative Laminates**

BS 3794, Class 1 material.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

C. **Related Items**

- 05500 Metal Fabrications
- 06100 Rough Carpentry
- 06300 Wood Treatment
- 09900 Painting

D. **Submittals**

1. **Samples of Timber**

The Contractor shall provide for the Engineer's approval samples of each species of timber he wishes to use, 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. **Alternative Timbers**

If the Contractor wishes to use a timber outside the range of specified timbers he shall submit for approval samples of the species for which it is an alternative.

3. **Plastic Laminate and Veneer Samples**

Samples of each type of plastic laminate and veneer shall be submitted for approval.

The samples shall be 1m x 1m applied to their specified backing, and shall have two adjacent edges finished as they will be in the work, including concealed or exposed lipping, chamfering etc., and showing the method of forming and finishing corners.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

D. Submittals (Cont'd)

3. Plastic Laminate and Veneer Samples (Cont'd)

Where these materials are specified to receive an applied finish half of the sample is to be so finished.

4. 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, latte, or other board or sheet material specified, or which the Contractor wishes to use appropriately labeled as in D1 above.

5. Prototype Components

For all repetitive items a prototype is to be prepared for approval, which must be obtained before the main production of each item is commenced.

6. Drawings

Before fabrication is commenced shop drawings of each item which requires such 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.

7. Manufacturer's Data

Data covering Specification, recommendation and instructions shall be submitted for the Engineer's consideration on manufactured components, proprietary fittings, sheet, board and laminate materials and adhesives. Where applicable this data shall indicate compliance with the Specification.

8. 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. Identification

Fabricated items shall be clearly identified by marking or secure labeling, but marking shall not be applied to any surface which will be visible in the finished work.

3. 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.

4. 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 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.

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.

ARCHITECTURAL WOODWORK (06400) (CONT'D)**F. Materials (Cont'd)****7. Medium Density Fiberboard (MDF)**

The various type and qualities of fiber boards shall comply in all relevant respects with BS 1142, fiber building boards, for insulating board, standard hardboard and medium hardboard in accordance with section 2 that standard.

8. Veneers

Wood veneers shall be of the timber varieties shown on drawings: all sheets of one variety shall come from the same source. Veneers shall be hard, free from disfiguring defects to the satisfaction of the Engineer, capable of being easily finished to a smooth surface, and consistent in colour and grain.

9. Plastic laminates

Decorative plastic laminates shall be "Formica", "Polyrey" or approved equal and with better performance, and shall comply in all relevant respects with BS 3794, Decorative Laminate Plastic Sheet, for a Class 1 material, and shall be from an approved manufacturer, selected by the Engineer and in accordance with approved samples of colour and pattern. They shall be high pressure, general purpose type, premium grade of a minimum thickness of 0.9mm.

Balancing plastic laminates shall have such properties that they will accurately balance the face sheet and ensure resistance to deformation of finished work.

Shall be of type, finish and thickness specified herein. Color shall be selected from manufacturer's standard range of colors.

10. 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 and Laminboard: adhesives shall comply with BS 1203, WBP Grade.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

10. **Adhesives (Cont'd)**

- 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.

11. **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.

12. **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.

13. **Bolts**

Bolts shall be steel and comply with BS 916 and washers to BS 3410, Part 2.

14. **Hardware and Accessory Materials**

- a. Provide cabinet hardware and accessory materials associated with architectural woodwork and as specified herein.
- b. **Cabinet hardware:** Contractor shall include specific hardware and accessory items required for architectural woodwork, and shall ascertain the general scope and quantity of items required from his observations made of the drawings, specifications and jobsite mockups. The drawings are not to be considered encompassing and shall not act to limit the overall scope of work of this section. Contractor shall provide a complete job, with necessary items of cabinet hardware.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

15. **Approved Manufacturers**

All wood used under this section such as chipboards, MDF panels, plywood panels, latte boards, etc... shall be of products manufactured by “Fantoni” or approved equal and with better performance.

G. **Workmanship**

1. **General**

Sizes, thicknesses and methods of fixing shown on the drawings and stated in the Breakdown of lump Sum and 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.

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.

ARCHITECTURAL WOODWORK (06400) (CONT'D)**G. Workmanship (Cont'd)****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.

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.

ARCHITECTURAL WOODWORK (06400) (CONT'D)**G. Workmanship (Cont'd)****11. Bonding of Plastic Laminate**

Bonding must be under pressure using the specified and approved adhesive in accordance with the manufacturer's instructions.

Balancing veneers shall always be used, and for surfaces not visible these can be standard brown laminate veneer made for this purpose.

Where specified or shown on the drawings that the laminate is carried over the edgings, it shall be brought flush with the face of the edging and then finished with a chamfer at 60° to the face of the panel for the full depth of the laminate.

Panels shall be faced on each side with a single sheet of laminate. Finished laminate faces shall be flat and true, free from warping, waving, high or low spots. Spalling of the edge of laminate will not be accepted.

12. Decorative Wood Veneers

The decorative wood veneers shall be laid at right angles to the grain of the plywood or blockboard backing. The moisture content of the veneer shall match that of the backing.

The veneer shall be finished by fine sanding or scraping to eliminate high spots or undulations.

13. Core Construction

All cores to panels or components shall be solid and of the same material throughout and shall be chipboard, plywood, laminboard or blockboard, as specified or shown on drawings. The core to fire doors shall be fire resistant mineral or extruded particle board as described herein where the drawing indicates a fire resistant requirement. The core shall be in one piece in any one panel.

14. Hardwood Edgings

All cores shall be edged all round with hardwood to match the timber veneer or as specified. Tongues between edgings and cores, whether or not shown on drawings, may be considered as optional and may be omitted if the Contractor undertakes to provide equally strong glued joints without a tongue. Edgings shall be applied with adhesive, not panel pins, and shall be sanded flush with the core material before veneering. Exposed corners shall be precisely mitred.

ARCHITECTURAL WOODWORK (06400) (CONT'D)**G. Workmanship (Cont'd)****15. Prefabricated Fittings**

Fittings such as floor and wall cabinets and cupboards, counters and such like shall be constructed as detailed on the drawings and all constituent materials shall be specified herein. Doors and drawers shall operate smoothly and shall be fitted with minimum tolerances consistent with such operation.

16. Ironmongery and Hardware

Install specified ironmongery and all items of hardware associate with Architectural Woodwork in accordance with manufacturer's instructions and lubricate operating mechanisms as required.

Provide hardware and accessory materials for the vanities, cabinets, cupboards, closets, etc.. as follows (unless otherwise required by the Engineer):-

1. Hinges: Plain bearing two knokle steel hinges (3 No. per door leaf).
2. Knob for door panels: Brushed stainless steel (1 No. per door leaf).
3. Lock: Cabinet lock for each door panel or couple of panels as appropriate with security cylinder.
4. Knob for drawer (1 No. per drawer).
5. Drawer runners: Steel telescopic runners (full width of drawer on both sides).
6. Chrome pins for adjustable shelves.
7. Chrome hanging rods, fixed and movable

17. 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, rawbolts, grout, lugs, packings, grounds etc. required to fabricate components and complete the installation.

18. 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 above.

ARCHITECTURAL WOODWORK (06400) (CONT'D)**G. Workmanship (Cont'd)****19. Scribing**

All skirtings, architraves, cover strips, scribing fillets etc., which are required to have a close butt connection to floor, wall or other adjacent surfaces shall be accurately scribed to fit thereto. They shall be in long lengths, with joints scarfed, mitred on external corners and square butted and scribed at internal corners.

20. 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.

21. 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 approved hard stopping.

22. 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.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

23. **Final Finishing**

Ensure after fixing that all work is cleanly finished and ready to receive Site-applied finishes.

24. **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.

25. **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.

26. **Fabrication of specific items**

- a. **Design and Construction Features**: comply with details shown for profile and construction of architectural woodwork; and, where not otherwise shown, comply with applicable Quality Standards and with alternate details of fabricator subject to Engineer's approval.
- b. **Precut Openings**: Fabrication architectural woodwork with precut openings, wherever possible, to receive hardware, appliances, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutouts and, where located in countertops and similar exposes, seal edges of cutouts with a water-resistant coating.
- c. **Measurements**: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain measurements and verify dimensions and shop drawing details as required for accurate fit. Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

26. **Fabrication of specific items (Cont'd)**

d. **Frames for Door Moldings**

- i. Grade: premium
- ii. Species: as indicated on drawings and in Breakdown of Lump Sum and Bills of Quantities.
- iii. Fabricate work to profiles, sizes, shapes, dimensions, and thicknesses detailed and indicated. Rout or groove reverse side (backed-out) of trim members to be applied to flat surfaces, except for members with ends exposed in finished work.

e. **Doors**

- i. Species: as indicated on drawings and in Breakdown of Lump Sum and Bills of Quantities.
- ii. Grade: Premium
- iii. Stiles and rails and similar principal members shall be of solid softwood or hardwood construction as indicated on drawings. Panels shall be of painted or veneered or laminated construction, as indicated on drawings using edge-glued core material with face veneers or laminates of 3.2mm (1/8 inch) minimum thickness of species and grain to match stiles and rails.
- iv. Fasteners shall be concealed (blind).

f. **Vanities and Cupboards Miscellaneous Construction Members, such as bases, partitions, top, bottom and side pieces, adjustable shelves, drawers, framing, etc...**

- i. Grade: premium
- ii. Species: as indicated on drawings and in Breakdown of Lump Sum and Bills of Quantities.
- iii. Fabricate work to profiles, sizes, shapes, dimensions, and thicknesses detailed and indicated.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

26. **Fabrication of specific items (Cont'd)**

g. **Plastic Laminate Finished Cupboards and Doors**

- i. Species: as indicated on drawings and in Breakdown of Lump Sum and Bills of Quantities.
- ii. Grade: Premium
- iii. Fabricate exposed edges of doors and casework, including edges of panels and drawers when open with matching plastic laminate. Fabricate inside surfaces with matching plastic laminate.

h. **Shelving for Plastic Laminate Cupboards and Casework**

- i. Species: Plastic laminate, as indicated on drawings and as approved by the Engineer.
- ii. Grade: Premium.
- iii. Edging: 20mm x 40mm solid hardwood facing only.

j. **Finishing**

- i. The entire finish of architectural woodwork is work of this section, regardless of whether shop applied or applied after installation.
 - a. Shop finishing: to the greatest extent possible, finish architectural woodwork at shop or factory. Defer only final touchup, cleaning and polishing for time after delivery and installation. The priming and prefinishing of architectural woodwork required to be performed at the shop, factory or in the field is specified as work of this section.
 - b. Preparations for finishing: sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

26. **Fabrication of specific items (Cont'd)**

j. **Finishing (Cont'd)**

ii. **Transparent Finish**

General finish standard: open grain finish.

- a. Shop application: Stain and sealer (match approved sample for color)
- b. Final finish: sanding, followed by 2 coats of polyurethane filler and finish, to produce finish equal to or exceeding finish of previously erected jobsite mockup.

iii. **Paint Finish**

- a. General finish standard: closed grain finish.
- b. Machine sand 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 1200 grade. Clean wood and immediately apply primer.
- c. Shop application: apply primer specified herein to a minimum dry film thickness of 50 micrometers (2.0 mils) in accordance with manufacturer's recommendations.
- d. Sand primer surfaces with 220 grit striated paper and completely clean.
- e. Shop Application: Apply topcoat paint specified herein in accordance with manufacturer's recommendations. Lightly sand between coats and completely clean prior to application of subsequent coat.
- f. Mix and prepare painting materials in strict accordance with the manufacturer's directions.

ARCHITECTURAL WOODWORK (06400) (CONT'D)

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

26. **Fabrication of specific items (Cont'd)**

j. **Finishing (Cont'd)**

iii. **Paint Finish (Cont'd)**

- g. Stir materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not sir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.
- h. Tint each undercoat a slightly different shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Tint undercoats to match the color of the finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Provide a code number to identify material tinted by the manufacturer.

DIVISION 7

THERMAL AND MOISTURE PROTECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

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WATERPROOFING (07100)

A. Scope

1. This section specifies the provision and installation of the complete waterproofing systems for the works as detailed on the drawings and as indicated in the drawings and Bills of Quantities.
2. All waterproofing work shall be carried out by a Specialist Sub-Contractor having at least 10 years experience in applying waterproofing system especially waterproofing membrane.
3. Work under this section includes but not limited to waterproofing system to roofs and top roofs, balconies, terraces, wet areas, exterior paved areas, planters and gardens, under raft foundations, Single foundations, sump pits, water tanks, and facades behind mechanically fixed cladding.

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 +45°C nor under conditions of thermal shock.
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 +45°C range.
6. All materials shall be of a standard not less than that set out in the current editions of all relevant British Standards.

WATERPROOFING (07100) (CONT'D)**B. Performance and Standards (Cont'd)****7. Qualification**

The waterproofing systems including protection and all associated accessories and works shall be executed by a specialist firm(s) having at least 10 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.

C. Related Items

03300 Cast-In-Place Concrete
03500 Beds and Screeds
04400 Stone
07600 Flashing and Sheet Metal

D. Submittals

1. Prior to commencing work, the Sub-contractor shall obtain from the membrane manufacturer full application 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.

WATERPROOFING (07100) (CONT'D)

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

5. **Guarantee**

Material manufacture's warranty: written warranty, signed by water proofing manufacture agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight within specified warranty period which is Twenty (20) years after date of substantial completion.

Application warranty: 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 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 including manufacturing date and expiry.

WATERPROOFING (07100) (CONT'D)**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.

2. Waterproofing Systems

The waterproofing works shall include water cut-off sealant, PU mastic sealant, bonding adhesive, backing rod, cured and uncured elastomer flashing, extruded aluminium flashing, PU mastic pointing, reinforced EPDM strips, cured and uncured cover strips, stainless steel termination bars and fasteners, non shrink mortar and grout, angle fillets at perimeters, epoxy grout, splicing cement, adhesives.

The waterproofing systems shall be as shown and as detailed on the drawings and as indicated in the Breakdown of Lump Sum and Bills of Quantities, complete including all requirements and elements needed to provide water tight surfaces preventing any water penetrations; including but not limited to:

A. BELOW GROUND**A1 Footings**

- Two coats of bituminous materials.

A2 Peripheral Walls of basement

- Water proofing membrane SBS.
- Propolyene protection boards.

A3. Ground floor above basement

- Two layers of SBS.
- HDPE drainage and protection board

A4. Wet areas (Toilets & kitchens)

- 3 coats of Polyurethane liquid applied membrane
- Non-woven geotextile 300 gr/m2 over Polyurethane liquid applied membrane

A5. Roof

- Waterproofing membrane Two layers of SBS for horizontal surfaces, over screed laid to slope, and fully adhered for vertical surfaces, stairs, and upstands, with extruded aluminium flashing and PU mastic sealant and insulation
- Non-woven geotextile 150 gr/m2 over HDPE drainage board
- Cement tiles laid loose or
- Gravel 50mm thick

WATERPROOFING (07100) (CONT'D)**F. Materials (Cont'd)****3. Bituminous Waterproofing Coating:**

Materials - The rubber bitumen emulsion shall be a water bound emulsion with a minimum 60% total solids content by volume, comprising bitumen with fine particles of rubber. Not less than 10% nor more than 20% of the total solids shall be rubber. The consistency shall be such that it can be applied to the surface by brush at normal temperature.

Application - Before the application of rubberized bitumen emulsion the concrete surfaces shall be thoroughly cleaned and made free from dirt, dust, grease and other extraneous matter and lightly brush dampened immediately prior to application of the emulsion.

The priming coat shall be made up by mixing 0.23 kg of approved powder detergent or the equivalent of liquid detergent, with 45 litres of clean water and adding this to 4.5 litres of emulsion. The priming coat shall be applied at the approximate rate of 9 litres per 30 m².

The second coat consisting of undiluted emulsion shall be applied as soon as the priming coat is dry, at the approximate rate of 9 litres per 15 m².

The emulsion shall be applied by brush, squeegee or spraying strictly in accordance with the manufacturer's instructions, It shall not be applied during or when rain or dust storms are to be expected.

Backfilling shall not be commenced until the second coat of emulsion is quite dry.

4. Waterproofing Membrane (SBS) System:

Materials: Provide Torch Applied Waterproofing Membrane: Provide torch-applied waterproofing membrane of minimum **3mm thickness** to the general requirements of UEATc MOAT 27- 1983.

Torch applied waterproofing membrane shall be **SBS (Styrene Butadiene Styrene) modified bitumen to the requirements of UEATc MOAT 31 –1984.**

Primer: Compatible with the type of the waterproofing membrane and as recommended by manufacturer.

Installation: In accordance with UEATc Standards and as recommended by the manufacturer and approved by the Engineer.

5. Liquid-Applied Waterproofing on the Facades (if applicable as per Drawings)

The liquid applied waterproofing incorporates Polyurethane liquid designed to create a seamless waterproofing membrane to the building facades under the stone cladding.

The liquid applied waterproofing must meet ASTM C 836 High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for use with Separate Wearing Course.

LIQUID MEMBRANE:

The liquid applied water proofing shall be a one component polyurethane fluid that cures with the humidity in the atmosphere. It should produce an elastic strong film with excellent adhesion to different surfaces. The liquid applied waterproofing membrane contains 95% dry matter in Xylol.

Minimum Requirements:

Density	: 1.4 Gr/cm ³ – ISO 2811 - DIN 53217 – ASTM D 1475 @ 20° C
Viscosity	: @ 20°C – ASTM D 1200/88 – 5000 Cst >> 10% Toluol in the product 1000 Cst
Flash point	: 37°C
Elasticity	: More than 400% - DIN 53217 – ASTM D412
Hardness	: 70 Shore A – ISO R 868 – DIN 53 505 – ASTM D 2240
Service temperature	: -50°C Up to 90°C
Max. Temperature (shock)	: 250°C
Tensile strength at break	: 60 Kp/cm ² – DIN 52455 – ASTM D 412
Weather resistance	: Federal specifications SS-S-200D on Weather-O-meter.
Stability	: Min 12 months

SEALANT:

Provide Polyurethane mastic sealant: one component polyurethane sealant that cures by the moisture, to form a tough & elastic seal with a wide temperature application range.

Density	: 1.2 gr/cm ³ , ISO-2881, DIN 53217, ASTM D 1475 At 20° C.
Hardness shore A	: 25-30, ISO R868, DIN 53505, ASTM D 2240
Service temperature	: -40° C to 90° C, shock at 120° C
Application temperature	: 5° C up to 40° C
Touch free	: 1 – 2 hours
Cure rate	: approx. 1 – 2 mm/day
Elongation at brake	: > 900% DIN 52455

Tensile strength	: 50% elongation 2.5 kp/cm ² , DIN 52455
100% elongation	3–3.5 kp/cm ² , DIN 52455
Resilience	: >90% DIN 52458
Toxicity	: No restrictions as cured.

The holes resulting from the insertion of stonework mechanical fixation into the liquid membrane system should be sealed with adequate sealant as per the waterproofing manufacturer recommendations.

EXECUTION:

SURFACE PREPARATION:

New concrete shall be water cured at least for 28 days.

Surfaces shall be structurally sound, dry, and free from oil, grease, dirt, laitance, curing or release agents and other contamination which may harmfully affect the adhesion of the membrane.

Remove splatters, fins, ridges or other projections to provide a smooth, level surface.

Closing all concrete's pockets such as steel reinforcement, honeycombing, pipes and grooves using Single-component structural mortar.

Covering all bar holes, if exists, by inserting a piece of backing rod inside the holes and patching it using the Single-component structural mortar.

APPLICATION:

Apply the first coat of polyurethane to the entire area to receive waterproofing, including over all detail coats.

Apply the second of polyurethane to the entire area with an interval of 24hours.

Over all coverage is $\approx 1.5 \text{ kg/m}^2$

DETAILED WORKS:

Apply a 10 mm, 45 degree angle polyurethane mastic sealant cant at the juncture of all vertical and horizontal surfaces including at other projections and all concrete hair cracks prior the application of the first coat of polyurethane.

6. Internal Treatment of Water tanks GRP lining

All interior surfaces of concrete water tanks shall be waterproofed with minimum 5mm thick GRP Lamination in accordance with the following:

Raw Materials	Emulsion bound Chopped Strand Mat (CSM) General purpose Polyester Resin
Process	Manual Application
Tensile Strength	93 N/sq.mm.
Flexural Strength	141 N/sq.mm.
Thermal Conductivity	0.15 – 0.17 W/(M - K)
Water Absorption	Not greater than 0.2%

The liner shall consist of a three-part system involving:

- (1) The use of a primer/sealer base coat applied in a minimum of two coats to completely saturate and seal the porous concrete surface;
- (2) A secondary coating of reinforced epoxy resin using a chopped glass fiber roving or glass flake type reinforcement of minimum 29% reinforcement to resin ratio by weight, applied in two coats to a minimum dry film thickness of 2.5 mm; and
- (3) A final surface coating of non-reinforced epoxy gel(resin) to a minimum dry film thickness of 0.35mm. The sealer/primer base coating shall be a type as recommended by the coating process manufacturer/subcontractor, and if not recommended by this manufacture then the primer shall be penetrating epoxy sealant meeting the requirements for Sealant of this specification.

The glass reinforced epoxy (GRP) layer shall be a two-part epoxy resin reinforced by type ECR chopped glass fibers or glass flakes of types, physical properties and quality as recommended by the approved manufacturer and application subcontractor. The final non-reinforced resin layer shall be of same type epoxy resin as used for the reinforced epoxy resin layer.

Each sealer/primer, and reinforced and non-reinforced resin coats shall be colored, using color additives of different colors, to assist in the inspection of coating layers. The outer final coating layer shall be of a bright, light reflective coloring. The Contractor shall follow all safety and application guidelines suggested by the manufacturer and shall supply five (5) extra sets of top quality safety equipment (respirator, goggles, and safety coverings for clothes and skin areas) for the Engineer's use, as approved by the Engineer. The interior areas shall be constantly force – air ventilated and all workmen suitably protected during application and curing of spray-on GRP liners

7. EPDM MEMBRANE

Provide 1.5mm (.060”) thick black, non-reinforced EPDM (Ethylene, Propylene, Diene Terpolymer) membrane in the largest sheet possible. The membrane shall conform to the minimum physical properties of ASTM D4637. The membrane shall be fully adhered.

The membrane shall have the following indicated properties:

WATERPROOFING (07100) (CONT'D)

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

TYPICAL PROPERTIES AND CHARACTERISTICS				
			- - - Typical - - -	
Physical Property	Test Method	SPEC.(Pass)	Standard	FR
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10	±10
Weight, 1bm/ft ² (kg/m ²) .045 .060		...	0.26 (1.3) 0.35 (1.7)	0.26 (1.3) 0.35 (1.7)
Tensile Strength, min, psi (Mpa)	ASTM D 412	1305 (9)	1630 (11.2)	1630 (11.2)
Elongation, Ultimate, min, %	ASTM D 412	300	480	480
Tear Strength, min, lbf/in (kN/m)	ASTM D 624 (Die C)	150 (30.6)	200(40.3)	200 (40.3)
Factory Seam Strength, min.	Modified ASTM D 816	Membrane Rupture	Membrane Rupture	Membrane Rupture
Resistance to Heat Aging Properties after 4 weeks @ 240°F(116°C)	ASTM D 573			1500
Tensile Strength, min, psi (MPa)	ASTM D 412	1205 (8.3)	1500 (11.0)	(11.0)
Elongation, Ultimate, min, %	ASTM D 412	225	310	310
Tear Strength, min, lbf/in (kN/m)	ASTM D 624	150 (26.3)	240 (42.0)	240 (42.0)
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.4	-0.4
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks	No Cracks
Brittleness Temp., max, °F (°C)	ASTM D 746	-75 (-59)	-85 (-65)	-85 (-65)
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	4.0	2.0	2.0
Water Vapor Permeance max, perms	ASTM E 96 (Proc. B or BW)	0.10	0.05	0.05
Resistance to Outdoor (Ultraviolet) Weathering Xenon-Arc, 7560 kJ/m ² total radiant exposure at 0.70 W/m ² irradiance, 80°C black panel temp.	ASTM G 4637 Conditions	No Cracks No Cracking	No Cracks No Cracking	No Cracks No Cracking
Sheet Composition Weight percent of polymer that is EPDM, min, % Weight percent of sheet that is EPDM polymer, min, %	ASTM D 297	100 30	100 30	100 30

WATERPROOFING (07100) (CONT'D)**F. Materials (Cont'd)****EXECUTION:**

The substrate has to be clean, free from oil, grease, paints and in general any other materials, which could compromise the adhesion of the membrane. It is necessary to adjust eventual unevenness with suitable mortar.

Create a groove at all vertical/horizontal corners, around all penetrations and at construction joints using a power chisel, and then closing it with non-shrink structural mortar.

MEMBRANE PLACEMENT AND ATTACHMENT

Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

G. Workmanship**1. Conditions of Screed and Surrounding Walls**

Before laying the membrane, ensure that the screeds or concrete surfaces are to the correct falls, and that any preliminary preparation work including the formation of grooves is complete. The screed and concrete surfaces 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 membrane, nor shall it be use as a building platform.

3. General

The whole of the waterproofing systems, flashings and formed fittings shall be carried out completely in accordance with the manufacturer's instructions.

The membrane shall be laid in the direction flow of the water.

4. 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 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.

5. Completion

Leave all waterproofing clean on completion. Debris will not be accepted.

BUILDING INSULATION (07210)

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Concealed building insulation.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Product test reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

PART 2 - PRODUCTS

2.1 INSULATING MATERIALS

- A. **General:** Provide insulating materials that comply with requirements and with referenced standards and, for preformed units, in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.
- B. **Extruded Polystyrene Insulation Board:** ASTM C 578, (35 kg/cu. m), with maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
The thermal insulation material shall be an inorganic plastic material and preformed into rigid foam slabs by pressure extrusion method. The foaming and extrusion process shall ensure 100% closed cell formation and smooth hard unbroken skin on all external faces. It shall be type A, grade SHD (extruded boards with skins) having a standard dimension of 1250 x 600 x 50 mm.

The material shall exhibit the following characteristics:

Five year aged average thermal conductivity of maximum 0.032 W/mk when tested at 24° C. in accordance with DIN-52612 or ASTM C-518-76, C-177-76.

Compressive strength of 43 psi or 300 kps average when tested in accordance with DIN-53421 or ASTM D-1621.

Water absorption of maximum 1% average when tested in accordance with ASTM D-2842.

Water vapour permeability of 0.6 perm inch average when tested in accordance with ASTM C-355-64.

- C. **Mineral Wool Insulation:** Where indicated on Drawings (such as on top of MEP room at roof Areas) a 50mm thick mineral wool insulation shall be used with the required type to be of density (32 kg/m³).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install insulation to comply with insulation manufacturer's written instructions applicable to products and application indicated. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement
- B. Installation of General Building Insulation: Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
1. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant.
 2. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 - a. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 3. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

- a. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - b. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
4. For wall cavities where cavity heights exceed 2400 mm support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
 5. Retain insulation in place using clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of
 6. Place insulation into spaces and onto surfaces as shown.
- C. Installation of Vapor Retarders: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
1. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 400 mm o.c.
 2. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor-retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
 3. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.
 4. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
 5. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

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.
- Architectural Sheet Metal Manual.
 - b. ASTM - American Society for Testing and Materials.
A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
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 1mm 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 reglets, 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 reglets, 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 reglets, 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.

JOINT SEALERS AND ADHESIVES (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 ADHESIVES (07900) (CONT'D)

C. **Related Items**

- 07100 Waterproofing
- 08120 Aluminium Windows
- 08540 Aluminium Doors
- 08550 Aluminium Shopfronts

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.

JOINT SEALERS AND ADHESIVES (07900) (CONT'D)**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 (depending on indication shown on Drawings):
 1. Where indicated on Drawings and required by the Engineer the use of Polysulfide Sealant shall meet the following requirements:
Pourable, two-component, cold-applied, self-leveling polysulfide based joint sealant with the following performance specifications:
 - a. Consistency: Liquid, Self-Leveling.
 - b. Application time (77° F - 50% RH): 1 hour.
 - c. Tack-Free Time: 4 hours.
 - d. Linear Shrinkage: Negligible.
 - e. Shore Hardness: Shore A 20 ± 5.
 - f. Tensile Strength: 125 - 200 psi. (862 – 1379 KPa)
 - g. Elongation: 500%.
 - h. Peel Adhesion (ASTM C794): 20 lb./in. min. (357 g/mm).
 - i. Colours to match adjacent materials from manufacturer's standard colours.
 2. Where indicated on Drawings and required by the Engineer the use of Polyurethane Sealant shall meet the following requirements: 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.

JOINT SEALERS AND ADHESIVES (07900) (CONT'D)**F. Materials (Cont'd)**

3. Sealant: One part low modulus sealant of approved manufacturer with a Shore A hardness of 22 conforming to Federal Specification TT-S-001543 A and TT-S-00230C and ASTM C920. Colours to match adjacent materials from manufacturer's standard colours.
4. In general, 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.

Where indicated on Drawings **Fire Rated Sealants shall consist of the following:** One part rubber sealant for use in passive fire protection of approved manufacturer with a shore A cured hardness of 15-20 ASTM E-814 (UL 1479) and ASTM E-119 (UL 263).

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.
4. Adhesives: Adhesives shall be the type recommended by manufacturer for the application indicated on drawings.

For ceramic tiles and where required that adhesives be used as shown on Drawings, or stated in the Bills of Quantities, adhesive material shall conform to the requirements of American National Standards Institute (ANSI) - A136.1, American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile.

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.

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

DIVISION 8

DOORS AND WINDOWS

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STEEL DOORS (08110)**A. Scope**

This work shall include for the supply, installation and fixing of welded galvanized steel doors as shown on the drawings and door schedules and as indicated in Breakdown of Lump Sum.

The term "doors" in this section shall also include fire rated doors, windows, louvers, vision panels, and frames manufactured in steel.

B. Performance and Standards

1. Steel doors shall comply with BS 1245. All mild steel shall comply with BS 4630 and with BS4, Part 1. All sheet steel shall comply with BS 1449, Part 1.

2. 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, louvers, and vision panels used on fire rated doors should comply to same standards of fire rating as doors and in specific of same fire rating hours.

3. Quality Assurance:

- 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. 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 minimum 5 (*five*) years in such a trade.

C. Related Items

05010 Metal First Fixing Materials

05030 Metal Finishes

05500 Metal Fabrications

08200 Steel Access Panels

08700 Ironmongery

08800 Glazing

09900 Painting

STEEL DOORS (08110) (CONT'D)

D. Submittals

1. Samples of Doors

The Contractor shall provide for the Engineer's approval one full mock up door sample installed on site.

2. Drawings

Fully detailed shop drawings showing door frame, louvers, vision panels, and hardware shall be submitted to the Engineer for approval before fabrication commences.

3. Ironmongery

The Contractor shall supply to the manufacturer of doors samples of all item of ironmongery as specified which will be fixed to the frame 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 are to be given to the manufacturer before production is commenced.

4. 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.

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 frames shall be removed from the site and replaced at no additional cost.

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. Crates shall similarly clearly identify their contents.

STEEL DOORS (08110) (CONT'D)**E. Product Handling (Cont'd)****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

Storage on site shall be in dry conditions. Doors shall be stored in such a way that they are not liable to distortion caused by undue weight in stacking.

F. Materials**1. 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.

2. Welding

Welding shall be in accordance with BS 693 or BS 5135 as appropriate.

3. Corrosion inhibiting coatings:

- a. Primer powder coating paint compatible with respective specified finish paint.
- b. All galvanized steel doors shall be supplied factory powder coating finished with the specified finish paint.
- c. Touch up damaged paint of same material at the building site after installation.

4. Inserts, Bolts and Fasteners

Manufacturer's standard units suitable for the function required.

STEEL DOORS (08110) (CONT'D)**F. Materials (Cont'd)****5. Fabrication General**

- a. Fabricate hollow steel units to be rigid, neat in appearance and free from defects, warp 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. 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 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.

6. Painting

- a. Pretreatment: Surface of metal to be pretreated with zinc salt phosphatizing for proper chemical conversion and protection of surface.
- b. Composition of paint: Hybrid resin epoxy polyester to provide paint with excellent resistance, light fastness, and heat resistance.
- c. Application: Apply zinc salt phosphatizing for pretreatment, final powder coating paint furnace treated at a temperature of 180°C for proper quality and durability paint, in addition to complete application and immersion of powder film.
- d. Thickness: Medium thickness of film to be between 60 to 100 microns.
- e. Finish: Ral color and appearance to the approval of the Engineer.

STEEL DOORS (08110) (CONT'D)**F. Materials (Cont'd)****7. Frames**

- a. Frame Construction: Frames are constructed of 1.5mm (16 gauge) commercial quality galvanized steel sheet for doors of 44mm thickness. All bends shall be formed with a true sharp radii.

Each jamb shall be provided with a sill anchor and two (2) jamb anchors for heights up to and including 1524mm and an additional anchor for each additional height of 762mm or a fraction thereof. For fire rated doors supply 4 jamb anchors on each side.

1. Frames: To be factory corner welded and assembled smooth. All welded frames shall be provided with a removable shipping strut welded across the jambs at the base. All welded frames must include the appropriate anchors to match the wall construction they are intended to be installed in and the appropriate hardware reinforcing. All frames to be installed grouted. *Grout fill shall be as per manufacturer's recommendation, to the approval of the Engineer.*

b. Hardware Preparation

1. Hinge Preparation: Provide frames with 5.0mm thick steel hinge reinforcements welded to the frames in compliance with BS 7352. Standard hinge preparation is to be 4" x 3" for regular weight, three preparations through 2286mm (7'6") height and four preparations over 2286mm (7'6") and up to 3048mm (10') height.
2. Strike Preparation: Provide frames with 3.0mm thick steel lock strike reinforcement with tapped holes welded to the frames. Standard strike preparation is to be for locks in compliance with doors manufacturer fire test.
3. Closer and Other Reinforcements: Provide all frames with minimum 2.0mm (14 gauge) reinforcement as necessary to support the scheduled hardware. Closers to be in compliance with EN 1144.
4. Plaster Guard: Provide 1.2mm thick steel plaster guard or mortar boxes at the back of hardware cut-outs in the frames.

STEEL DOORS (08110) (CONT'D)**F. Materials (Cont'd)****8. Doors**

- a. Door Construction: Provide doors of 44mm thick full flush construction fabricated from 1.2mm galvanized steel sheet to BS 4630. Provide top and bottom channel of 1.5mm thick steel welded to door skins on 150mm centers. Top channel is to be flush, bottom channel inverted.
- b. Core Construction: Provide doors with structurally bounded resin impregnated honeycomb to give extra sturdiness and rigidity, complying with BS 476 parts 20 & 22. Acoustic doors shall be 74mm thick and shall have special acoustic core construction as per manufacturer's recommendation to the approval of the Engineer.
- c. Hardware Preparation
 1. Hinge Preparation: provide doors with 5.0mm thick steel hinge reinforcements welded to the door skins. Standard hinge preparation is to be 4" x 3" for regular weight, three preparations through 2286mm height and four preparations over 2286mm and up to 3048mm height in compliance with BS 7352.
 2. Lock Preparation: Provide doors with 3.0mm thick steel formed lock reinforcements with tapped holes welded to the door skins. Provide internal reinforcements to support door skins as required for the type of lock that is specified. Standard lock preparation is to be for mortise lockset with a 76mm backset to manufacturer's test.
 3. Flush Bolt Preparation: Provide inactive leaf of pair door with 3.0mm thick steel flush bolts reinforcements at top and bottom.
 4. Closer and Other Reinforcements: Provide all doors with minimum 2.0mm (14 gauge) reinforcements as necessary to support the scheduled hardware. Closers to be in compliance with EN 1144.
- d. Vision Panels: Where vision panels are required by the plans, doors shall be provided with glass vision panels having the same fire rating as the doors, as per manufacturer's recommendation to the approval of the Engineer. Door supplier shall provide the cut-out and steel glazing bead.

STEEL DOORS (08110) (CONT'D)

F. Materials (Cont'd)

8. Doors (Cont'd)

- e. Louvers: Where louvers are required by the plans, provide louvers in the doors in compliance with BS 476 part 1. Louvered doors shall be provided with louvers including fly screens having the same fire rating as the doors, as per manufacturer's recommendation to the approval of the Engineer.
- f. Painting: After fabrication provide doors and frames thoroughly cleaned, coated with a factory powder coating with the required finished paint. Touch up damaged paint with the same finished paint material to be applied at the building site after installation.
- g. Fire protection
 - 1. Provide fire doors and frames tested in accordance with BS 476 parts 20 & 22.
 - 2. Labels: fire rated doors shall bear the appropriate fire labels.
 - 3. A labeled fire door must be installed with approved label hardware.
 - 4. Certificates: The Contractor shall provide certificates stating that all sizes and construction of fire doors are in compliance with fire tests approved by the Engineer.

G. Workmanship

1. Preparation

Steel shall be free of scale, dust, grease, oil and surface adhesives before priming.

2. Profiles

Profiles shall be formed as shown on drawings and shall be appropriate to the thickness of the doors.

3. Joints

Joints shall be welded to proper lines.

STEEL DOORS (08110) (CONT'D)

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

4. **Provision for Ironmongery**

The frames and door panels shall be factory-prepared to receive specified ironmongery.

- a. The hinges shall be welded to doors and frames.
- b. Striking plates for the specified locks and latches shall be fitted, complete with mortar guards.
- c. Bolt holes for double doors shall be drilled at works and provided with mortar guards.
- d. Fixings or all other specified ironmongery which fixes to the frame shall be provided, tapped as necessary, reinforced by backplates where necessary, and provided with mortar guards where the fixing penetrates the frame.
- e. The manufacturer shall make provision for and shall fit all items of ironmongery for the steel doors and frames.
- f. Where ironmongery is not specified for a particular door the provision of section 08700 shall apply.

5. **Frame Fixings**

The provisions for jamb fixing shall be as shown on drawings. In addition there shall be a mild steel horizontal plate at the foot of each jamb welded in all drilled with 6mm holes for fixing down to the floor. Frames shall be filled with grout.

6. **Alignment**

The doors supplier shall provide a steel for alignment purposes.

7. **Fixing**

Frame Installation: Contractor to provide installation of the frames plumb, square and in true alignment in compliance with BS 476 part 8. Use wood installations spreader at base, strike and mid-top locations to ensure constant and proper jamb opening for door.

Where frames are built in temporary struts shall be positioned between jambs to prevent bowing.

STEEL DOORS (08110) (CONT'D)

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

7. **Fixing (Cont'd)**

Doors Installation: Contractor to provide installation of the door plumb, square and in true alignment. Adjust doors to required clearances and tolerances complying with BS 476 parts 20 & 22.

8. **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 painting shall be made good immediately on completion of the frame and door fixing.

9. **Painting**

All frames and doors shall be factory painted in accordance 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, hinged panels, sliding panels, turn and tilt panels, spandrel panels, and fixed panels, aluminium sheet panels, louvers, grilles, and frames manufactured in aluminium as shown on the drawings and as indicated in the Breakdown of Lump Sum.
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.
4. This section shall be read in conjunction with section 08970. Where there is a conflict between this section and section 08970, the more stringent requirements shall be adopted at no extra cost to the Employer..

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 to the requirements of BS 4873.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)**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.

Sliding doors mechanism shall withstand a load of 250Kgs.

All aluminium openings shall withstand the thermal movement lateral impact force of 900 joules and wind load of 160 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 1/200 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 1/200.

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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

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 meter length of perimeter joint.

For opening lights the average leakage rate shall not exceed 6.5m³/h per meter 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)**B. Performance and Standards (Cont'd)****3. Performance (Cont'd)****f. Approved Subcontractor**

Approved Subcontractor for aluminium works shall have a proven experience of minimum ten (10) years in similar aluminium works and should have executed satisfactorily at least two building of 10 floors each. The approved Subcontractor shall be experienced in aluminium fabrication and installation and shall not subcontract any of his work to other companies.

C. Related Items

05010 Metal First Fixing Materials

05030 Metal Finishes

05500 Metal Fabrications

07900 Joint Sealers

08700 Ironmongery

08800 Glazing

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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)**D. Submittals (Cont'd)****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.

3. Sample Doors and windows

The Contractor shall supply for the Engineer's approval one complete sample of each separate door or 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 discretion a sample of any type of door or 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 Contractor. 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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)**D. Submittals (Cont'd)****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.

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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

E. **Product Handling (Cont'd)**

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 for single and double glazing, with powder coated finish as specified in Section 05030, supplied complete with frames, protruded members, sub-frames, mullions, transoms, sills, louvers, 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.

Aluminium profile extrusions shall be made from building – quality aluminium alloy 6060, and assembled by means of screws, junction blocks, or self-locating corner cleats.

Aluminium doors at roof shall consist of sandwich panel with aluminium sheet 1.5mm thick at both facings and extruded polystyrene infill core between the two sheets.

Surface finish of all aluminium works shall be durable synthetic powder coated applied by a qualified and approved applicator, such as Synthatec Premium or approved equal and with better performance, all to the approval of the Engineer. The Contractor or the Nominated Subcontractor shall furnish to the Engineer a written guarantee against failure of the finish over a twenty five year period subject to reasonable maintenance by the Employer as recommended by the applicator.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

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

1. **Aluminium Components (Cont'd)**

All sliding units shall be Sidem 2000 and shall have profile or approved equal and with better performance, with a frame depth of 140mm, lift and slide mechanism designed to withstand a load of 250Kg.

Refer to opening schedule for all types of doors and windows.

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.

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.

Single source responsibility: All accessories and gaskets shall be supplied from the same manufacturer and/or supplier.

2. **Aluminium Louvers**

Where required by the drawings within glazed aluminium units, provide louvers in compliance with SDI 111C.

The Contractor shall provide and install EPDM membrane conforming to ASTM D4637 type I with compatible seam tape all around aluminium louvers as recommended by manufacturer to provide tight connection for preventing water and air penetration, all to the approval of the Engineer.

3. **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)****4. Glass**

All glass and glazing materials, performance, and methods shall conform to the requirements of Section 08800, Glazing. Supplier shall verify that the designed thicknesses and types of glass will achieve the requested performance, and in case not, other glass thicknesses or types shall be recommended to the approval of the Engineer at no extra cost to the Employer.

The Contractor shall ensure that the type and weight of glass is fully in accordance with regulations for the safe glazing of doors and windows.

5. Weather-stripping

The weather-stripping shall be EPDM marine quality 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)****6. 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, including butts, hinges, locks, internal and external handles, kicking plates and push plates, flush bolts and door/window stops, concealed latches, etc... Hinged panels shall be provided with concealed hinges.

The manufacturer shall make provision for and shall fit all items of ironmongery required for such luxurious building.

Hardware, shall be aluminium, stainless steel, zamak or plastic, and shall be supplied from the same profile system manufacturer or approved equal and with better performance.

7. Water Bar

All doors and windows shall have a water bar of aluminium same colour as profile set in mastic.

8. Stainless Steel Bands

Stainless steel bands in aluminium doors and windows, where indicated on drawings, shall be of stainless steel grade 316L.

10. 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 to section 05010, Metal First Fixing Materials.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

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

11. **Paint System**

Paint system to be applied on exposed steel supporting corners behind stone cladding shall be as follows:

- Sand blasting after fabrication of corner to 2 ½ SA.
- Apply a coat of 75 microns of Zinc-rich epoxy Amercoat 68 SA.
- Apply 160 to 200 microns of high solid epoxy coating Amerlock 400C.

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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

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

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.

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.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)**G. Workmanship (Cont'd)****5. Fixing (Cont'd)**

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.

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 glass and glazing materials, performance, and methods shall conform to the requirements of Section 08800, Glazing.

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. Louvers

- a. General: Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
- b. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- c. Maintain equal louver blade spacing, including separation between blades and frames, to produce uniform appearance.
- d. Fabricate frames, to fit in sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.
- e. Include supports, anchorages, and accessories required for complete assembly.
- f. Provide vertical and horizontal mullions of type and at spacings indicated but not more than recommended by manufacturer.
- g. Provide extensions made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.
- h. Continuous, Horizontal, Drainable, Fixed-Blade Louvers in openable panels: *Synthatec premium powder coated finish aluminium* frames and louver blades with close-fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework. Blades designed to collect and drain water by means of gutters recessed from front edges of blades and by channels in jambs and mullions, with mullions recessed from front edges of blades so that blades have continuous appearance. Comply with the following requirements:

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)**G. Workmanship (Cont'd)****11. Louvers (Cont'd)**

- h. Cont'd
 - i. Louver Depth: (100 mm), unless otherwise indicated.
 - ii. Blade Thickness: (2.06 mm), unless otherwise indicated.
 - iii. Blade Profile: Drainable blade.
 - iv. Blade Angle: 45 degrees, unless otherwise indicated.
 - v. Free Area: 50%
 - vi. Exterior Corners: Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

- j. *Aluminium Louvers in openable panels: Synthatec premium powder coated finish aluminium louver blades and frames filled on interior with mineral-fibre, rigid-board, acoustical insulation that is retained by perforated-aluminium sheet; and complying with the following requirements:*
 - i. Louver Depth: (100 mm), unless otherwise indicated.
 - ii. Blade Thickness: (2.06 mm), unless otherwise indicated.
 - iii. Blade Angle: 45 degrees, unless otherwise indicated.
 - iv. Blade Spacing: As indicated.
 - v. Free Area: 50%
 - vi. Airborne sound-transmission loss rated as follows per ASTM E 413, determined by testing per ASTM E 90: STC Rating: 10.

- k. Louver Screens: Where required, provide louvers with louver screens complying with the following requirements:
 - i. Screen Location for Fixed Louvers: Interior face, unless otherwise indicated.
 - ii. Screening Type: Bird screening, unless otherwise indicated.
 - iii. Secure screens to louver frames with stainless-steel machine screws.
 - iv. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:
 - v. Metal: Same kind and form of metal as indicated for louver frames to which screens are attached. Reinforce aluminium screen frames at corners with clips.
 - vi. Finish: Same finish as louver frames to which louver screens are attached.

ALUMINIUM DOORS AND WINDOWS (08120) (CONT'D)

G. Workmanship (Cont'd)

11. Louvers (Cont'd)

- vii. Louver Screening for Aluminium Louvers: Fit aluminium louver screen frames with screening covering louver openings and complying with the following requirements: Bird Screening: (12.7-mm-) square mesh formed with (1.19-mm-) diameter stainless-steel wire.
- l. Fabricate aluminium louvers to dimensions and details indicated on the drawings but not less than required to support structural loads.
- m. Aluminium louvers shall be 100mm overall thickness, unless otherwise indicated, comprising aluminium frame, beams, supports, blades and all associated fixing accessories.
- n. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections and attachment of aluminium louvers to other work.
- p. Provide all necessary fixing accessories and anchorages with metal of the same material and finish as supported louvers, unless otherwise recommended by the manufacturer and approved by the Engineer.
- q. Finish designations prefixed by AA conform to the system established by the Aluminium Association for designating aluminium finishes.
- r. Colour: to be selected by the Engineer.

12. Completion

On completion, all work shall be left clean and free from damage or defect, to the satisfaction of the Engineer.

STEEL ACCESS PANELS (08200)

A. **Scope**

This work shall include for the supply, installation and fixing of fire rated galvanized steel access panels as shown on the drawings and schedules.

B. **Performance and Standards**

All sheet steel shall comply with BS 1449, Part 1.

Galvanized steel sheets shall comply with ASTM A123.

All steels used to manufacturer door faces shall meet the stretcher level standard for flatness.

Cold rolled steel shall conform to ASTM A366 or A620 and A568.

Hot rolled, pickled and oil steel shall comply with ASTM A569 and A568.

Hot dipped zinc coated steel shall comply with ASTM A526 or A642 and A525.

Electrolytically deposited zinc coated steel for anchors and accessories shall comply with ASTM A591 and A568.

Fire rated doors assemblies are to have been successfully fire tested to ASTM E152, ANSI/UL10b or NFPA 252.

Fire-Resistance Ratings: Wherever fire-resistance rating is required for construction in which access panels are to be installed, provide assembly of type and manufacturer listed by Underwriter's Laboratories, "Classified Building Materials Index". Provide UL label on each fire-resistance rated access panel assembly.

C. **Related Items**

06400 Architectural Woodwork

08110 Steel Doors

08700 Ironmongery

09900 Painting

STEEL ACCESS PANELS (08200) (CONT'D)

D. Submittals

1. Samples

The Contractor shall provide for the Engineer's approval one sample of access doors.

2. Drawings

Fully detailed shop drawings showing door frame and hardware shall be submitted to the Engineer for approval before fabrication commences.

3. Ironmongery

The samples and information are to be given to the manufacturer before production is commenced.

E. Product Handling

1. Handling Generally

All access doors and panels shall be carefully handled at works, during transportation and storage and on site to prevent damage. Any damaged or defective frames shall be removed from the site and replaced at no additional cost.

2. Identification

All access doors and panels 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. Crates shall similarly clearly identify their contents.

3. Protection

The access doors and panels 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

Storage on site shall be in dry conditions. Doors shall be stored in such a way that they are not liable to distortion caused by undue weight in stacking.

STEEL ACCESS PANELS (08200) (CONT'D)

F. **Materials**

1. **General Requirements**

- a. Provide access doors manufactured as integral units complete with frames, door panels, hardware and anchors, ready for installation.
- b. Fabricate units of continuously welded galvanized steel construction unless indicated otherwise in Drawings. Grind welds smooth and flush with adjacent surfaces.
- c. Provide attachment devices, anchors and fasteners of types and sizes necessary to secure access doors to supporting construction.
- d. Provide sleeved and groomed screwdriver operated cam locks in public areas; provide key operated flush cylinder locks for doors in nonpublic areas. Key all locks alike and furnish two keys per lock. Provide interior latch release on all doors used for man-access.
- e. Apply factory coat of rust-resistant primer paint to exposed steel surfaces not galvanized.
- f. Wood cladding to doors, materials and methods, shall comply with the requirements of Section 06400, Architectural Woodwork.

2. **Standard Access Doors**

- a. Access panels, frames, sheets, jambs, panels, hardware, etc... shall have the same specifications and shall be of the same galvanized steel material as specified in Section 08110, Steel Doors.
- b. Reinforce door panel on concealed side as required to prevent aging and surface deformations.
- c. Provide concealed spring type hinges in quantity required for length of door panel.

STEEL ACCESS PANELS (08200) (CONT'D)

F. Materials (Cont'd)

3. **Fire-Rated Access Doors**

- a. Fire rated access panels, frames, sheets, jambs, pabels, hardware, etc... shall have the same specifications and shall be of the same galvanized steel material as specified in Section 08110, Steel Doors.
- b. Construct frame sand door panels to comply with Underwriter's Laboratories, Inc. requirements for "B" label, 121°C rating. Attach underwriter's label on each access door assembly.
- c. Fabricate frame of galvanized steel with frame flange and approved anchors.
- d. Fabricate door panels of galvanized steel sheet, sandwich construction, with noncombustible insulation core.
- e. Provide continuous steel patio type hinge full length of door panel.
- f. Provide automatic panel closer for access doors larger than .09 sq. meter.

4. **Wood Cladding to Access Panels**

- a. Wood cladding to access panels, materials and methods, shall comply with the requirements of Section 06400, Architectural Woodwork.

G. Workmanship

1. **Inspection and Installation**

- a. Prior to installation of access doors inspect surfaces and construction to receive access doors. Do not install access doors until unsatisfactory conditions detrimental to proper and timely completion of work have been corrected.
- b. Comply with manufacturer's instructions for installation of access doors.
- c. Coordinate installation with work of other trades.
- d. Set frames accurately in position and securely attach to supporting construction with frames and door panels plumb, level and true in relation to adjacent finished surfaces.

STEEL ACCESS PANELS (08200) (CONT'D)

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

1. **Inspection and Installation (Cont'd)**

- e. Adjust hardware after installation for proper operation.
- f. Remove and replace doors, panels or frames which are warped, bowed or otherwise damaged.
- g. Galvanized steel access panels with wood cladding shall be supplied factory cladded unless approved otherwise by the Engineer.

WOOD DOORS (08210)

A. **Scope**

The work shall include the supply and fixing of internal wood door panels to be fixed on wood frames as indicated on the drawings and schedules.

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**

06400 Architectural Woodwork

08700 Ironmongery

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)**

3. **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. In general, all solid wood and wood veneers shall be American Walnut, unless otherwise indicated on drawings or approved by the Engineer.

2. Wood Frame

Wood frames shall be grooved to accommodate the door panel. Frame material and sizes shall be as shown on drawings and schedules and as described in the Breakdown of Lump Sum and Bills of Quantities. The frame shall be fixed to openings to the full width of the door frame with grooves all around. Each jamb shall be fixed to structural opening with anchor and 2 No. dovetail steel anchor for a height up to and including 1500mm and an additional anchor for each additional height of 750mm or a fraction thereof. In single leaf door, reinforce the jamb to the side where the lock will be fixed with additional anchor. Frame jambs shall be fixed from concrete floor level to lintel or other head structural members and wedged for solid aligned installation both vertically and horizontally.

3. Doors Core**a. Massive Wood Doors Construction**

Doors shall be solid massive wood of thickness as indicated on drawings and schedules and as described in the Breakdown of Lump Sum and Bills of Quantities.

The top and bottom rails shall be framed to vertical jamb members.

The assembled frame shall be precision planed or sanded to a true level surface before faces are applied, and opposite faces shall be truly parallel.

Provide rails, stiles, lipping, inserts and other face finish as detailed on the drawings.

b. Semi-Solid Core construction

Shall be of thickness as indicated on drawings and schedules comprising soft wood battens with minimum 5mm thick plywood or veneer facing on both sides and hardwood lipping all around as indicated on details and as described in the Breakdown of Lump Sum and Bills of Quantities.

The facing shall be tight butted throughout their length: battens shall be continuous through the height of the door except for rails at the top and bottom to which the battens are to be tight butted.

WOOD DOORS (08210) (CONT'D)**F. Materials (Cont'd)****3. Doors Core (Cont'd)****b. Semi-Solid Core construction (Cont'd)**

The top and bottom rails shall be framed to vertical jamb members.

The assembled frame shall be precision planed or sanded to a true level surface before faces are applied, and opposite faces shall be truly parallel.

Provide rails, stiles, lipping, inserts and other face finish as detailed on the drawings.

c. Hollow Core Construction

Shall be of thickness as indicated on drawings and schedules comprising battens placed apart of each other with 5mm thick plywood or veneer facing on both sides with hardwood lipping all around as indicated on details and as described in the Breakdown of Lump Sum and Bills of Quantities.

The facing shall be tight butted throughout their length: battens shall be continuous through the height of the door except for rails at the top and bottom to which the battens are to be tight butted.

The top and bottom rails shall be framed to vertical jamb members.

The assembled frame shall be precision planed or sanded to a true level surface before faces are applied, and opposite faces shall be truly parallel.

d. Facing

The final facing of the door shall be a substrate of plywood 5mm thick for painting or with American Walnut wood veneer. The substrate shall be fully bonded to the core.

e. Lipping

Doors shall be lipped on all vertical, horizontal and top edges with hardwood lippings of thickness as indicated on drawings and schedules. Lipping shall be in hardwood suitable in all respects for the finish to be applied.

WOOD DOORS (08210) (CONT'D)

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

4. **Fire Resisting Construction**

Shall 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 labeled for the required fire rating. The Contractor shall provide certificate from the manufacturer for all fire rated doors.

5. **Architraves**

Provide architraves of materials indicated to both sides of wood frame unless indicated otherwise.

Architraves shall be of same species of door and same finish, unless otherwise indicated on drawings.

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. **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.

8. **Finish**

Door panels for painting shall be painted with mat semi-gloss oil paint as specified in section 09900, stained with polyurethane painting.

9. **Clear Lacquer Finish**

All veneered doors shall be finished with minimum of six coats transparent satin finish, stained with polyurethane painting, from a manufacturer approved by the Engineer as specified in Section 09900.

WOOD DOORS (08210) (CONT'D)**F. Materials (Cont'd)**10. Veneers

Wood veneers shall be of the timber varieties shown on drawings: all sheets of one variety shall come from the same source. Veneers shall be hard, free from disfiguring defects to the satisfaction of the Engineer, capable of being easily finished to a smooth surface, and consistent in colour and grain.

11. Plastic Laminate

Shall be "Poleyrey", "Formica" or approved equal and with better performance.

G. Workmanship1. 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

The painting of doors is specified in section 09900. Doors shall be stained with polyurethane 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.

WOOD DOORS (08210) (CONT'D)

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

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.

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.

OVERHEAD COILING DOORS (08331)**PART 1 GENERAL****A. Scope**

The work shall include the supply and fixing of rolling shutter doors as indicated on the drawings and schedules.

1.1 Summary

This section includes the following types of overhead coiling doors:

- Rolling shutters

Extent of overhead coiling doors is shown on Drawings.

Provide complete operating door assemblies including curtains, guides, counterbalance mechanisms, hardware, operators and installation accessories, as indicated.

1.2 Submittals

1.2.1 Product Data: Submit manufacturer's product data, for each Overhead Coiling Door and accessories, include details of construction relative to materials, components, profiles and finishes. Provide roughing-in diagrams, and installation instructions for each type and size of overhead coiling door. Include maintenance data.

- Motors Show nameplate data and ratings, characteristics, mounting arrangements, size and location of termination lugs, conduit entry and coatings.

1.2.2 Shop Drawings: Submit shop drawings for fabrication, special components and installations which are not fully dimensioned or detailed in manufacturers product data.

Include plan, elevations and details of sections and connections. Show anchorage and accessories items. Provide templates for built-in or embedded anchors installed by others.

Detail wiring for power, signal, and control systems. Differentiate between manufacturer installed and field installed wiring.

1.2.3 Samples

Provide samples of each type of material required on size as indicated below:

OVERHEAD COILING DOORS (08331) (CONT'D)

- Curtain Flats 300 mm length
- Guides 150 mm length
- Brackets 150 mm square
- Bottom bar 150 mm length

- 1.2.4 **Fire Rated Doors:** Information describing fire release system, including testing and resetting, instructions.

Submit a certification of a testing agency that each door and frame assembly has been constructed to comply with design, materials and construction equivalent to labelled construction.

1.3 **Quality Assurance**

- 1.3.1 **Single Source Responsibility:** Provide each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting, and installation components.

- 1.3.2 Obtain operators and controls from the overhead coiling door manufacturer.

- 1.3.3 **Fire Rated Door Assemblies:** Provide assemblies that are identical to door and frame assemblies tested for fire-test-response characteristics and that are labelled and listed for fire rated indicated by authorities having jurisdiction.

1.4 **Performance Requirements**

Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stress without evidencing permanent deformation of door components:

- 1.4.1 **Wind Load:** Uniform pressure of 100 kg/m² acting inward and outward.

- 1.4.2 **Operating Cycle Requirements:** Design overhead coiling door components and operator to operate for not less than 10,000 cycles and for 10 cycles per day.

1.5 **Inserts and Anchorages**

Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of overhead coiling door units. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

See concrete and masonry specifications for installation of inserts and anchorage devices

OVERHEAD COILING DOORS (08331) (CONT'D)**1.6 Warranty**

Written warranty agreeing to repair or replace components of the door and the operator system that falls in materials and workmanship within 3 years from the date of substantial completion.

PART 2 PRODUCTS**2.1 Manufacturers**

Available manufacturers: Subject to compliance with requirements, manufacturers offering productions which may be incorporated in the work are limited to the manufacturer specialized in that kind of work and approved by the Engineer.

2.2 Door Curtain

Shutter curtains are constructed from continuously interlocked 73.6 mm curved section steel laths which are securely held in place by end locks.

Bottom rails are galvanised and roll-formed into and Tee section.

2.3 Guides

Guide section galvanised mild steel guides with slotted fixings for expansion in a fire are fixed to the jambs with continuous steel angles.

2.4 Endplates

Prime painted mild steel of appropriate thickness relative to door size.

2.5 Finish

Fire roll E240 is supplied with the majority of parts galvanised as standard. Where non-galvanised parts are utilized these are finished with one coat of primer paint.

2.6 TYPE OF OPERATION

Fire roll E240 can be manufactured with two modes of operation.

1. Chain operated
2. Electrically operated

OVERHEAD COILING DOORS (08331) (CONT'D)**2.7 Chain Operation**

Suitable for applications where the shutter is held open, closing only in the event of a fire.

Manual closing is achieved by releasing a pull cord which allows a controlled descent via a gear unit.

Opening is by means of a hand chain. Automatic closing in fire conditions is activated by a fusible link which releases the curtain with a controlled descent. Power operated shutters are recommended when everyday operation is required..

2.8 Electrical Operation

Suitable for all sizes of shutters, the Speed safe drive unit has a 240 volt 2 phase 50 Hz geared induction motor with an electro-magnetic brakes, limit switches, thermal release unit and a high level starter panel.

The design provide a fail safe system which will close the shutter automatically in the event of a fire situation and power loss. A controlled descent of 100 mm per second is an inbuilt safety feature.

Manual operation in the event of a power loss is achieved by releasing a pull cord to close the shutter under controlled descent and a hand chain to open.

Each fire shutter is individually operated from a control station. Incorporating three push buttons positioned adjacent to the shutter guide on the motor side at approximately 1450 mm from the finished floor level, thereby permitting sight of the shutter during normal operation.

2.9 HEALTH & SAFETY

Power operated shutters are supplied with a controlled descent which can be initiated by conventional push button, smoke heat or alarm detection and can be backed up by mechanical fusible link.

PART 3 EXECUTION**3.1 Operation Cycle**

One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

OVERHEAD COILING DOORS (08331) (CONT'D)

3.2 **Installation**

Install door and operating equipment complete with necessary hardware, jamb, anchors and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.

Upon completion of installation, including work by other trades, lubricate, test and adjust door to operate easily, free from warp, twist or distortion.

3.3 **Painting**

Shop clean ferrous metal and galvanized surfaces exposed and unexposed, except paving and lubricated surfaces, with door manufacturer's standards rust inhibitive primer and standard powder coat applied finish consisting of primer and topcoat and, according to instruction for cleaning, pretreatment application and minimum dry film thickness.

IRONMONGERY (08700)

A. **General**

1. **Related Documents**

- a. Drawings and general provisions of Contract, including General and Supplementary Conditions and relevant Specification Sections, apply to this Section.
- b. This section provides performance specifications for the ironmongery required in the works..

B. **Summary**

1. **Section Includes**

Furnish, deliver and install all finish hardware necessary for all doors, 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. **Related Sections**

08110 Steel doors
08200 Steel Access Panels
08210 Wood Doors

C. **References**

1. European Norms for cycle test where applicable.

D. **Submittals**

1. General: Submit the following in accordance with Conditions of Contract and Specification sections.
2. 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)

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

3. Samples: Submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Samples shall be the property of the Employer.
4. Templates: Provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

E. **Quality Assurance**

1. Substitutions: Products are to be those specified to insure a uniform basis of acceptable materials. Requests for substitutions will require the Engineer's approval and must be made in writing. 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.
 - a. Items specified as "no substitution" shall be provided exactly as listed.
 - b. Items listed with no substitute manufacturers have been requested by the Engineer to match existing for continuity and/or future performance and maintenance standards or because there is no known equal product.
 - c. If no other products are listed in a category other than the one specified, then "no substitution" is implied.
2. Supplier Qualifications: A recognized architectural hardware supplier, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project. Having stocking facilities and maintenance service within the country.
3. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.

IRONMONGERY (08700) (CONT'D)

F. Delivery, Storage, and Handling

1. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
2. Each article of hardware shall be individually packaged in manufacturer's original container.
3. 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.
4. 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.
5. 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.
6. 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.
7. No direct shipments will be allowed unless approved in writing by the Contractor.

G. Warranty

1. Starting date for all warranty periods to be date of final handing over of the project.
2. No liability is to be assumed where damage or faulty operation is due to improper usage or abuse.
3. Provide guarantee from hardware supplier as follows:
 - a. Closers: Ten years, except electronic closers, two years.
 - b. Hinges: Life of the building.
 - c. All other Hardware: One year.

IRONMONGERY (08700) (CONT'D)

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

- d. 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.

H. **Maintenance**

1. 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.

J. **Products**

1. **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. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- d. Furnish items of hardware required to complete the work in accordance with these specifications and the manufacturers' instructions. Items of hardware not specified shall be provided even though inadvertently omitted from this specification. Items shall be of equal quality and type.
- e. Where the exact types of hardware specified are not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having as nearly as possible the same operation and quality as the type specified, subject to Engineer's approval.
- f. Carefully inspect Project for the extent of the finish hardware required to complete the Work. Where there is a conflict between these specifications and the existing hardware schedule, the more stringent requirements shall be adopted at no extra cost to the Employer.

IRONMONGERY (08700) (CONT'D)

K. **Materials**

Refer to Ironmongery Schedule forming part of the Contract Documents, in which the various hardware sets are detailed including their components, finish, and references, and quantities of the various components within each hardware set..

L. **Keying**

1. All locks and cylinders shall be keyed per the Engineer's instruction.
2. Provide 3 keys per lock.

M. **Key Control System**

1. Provide a key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of the number of locks required for the Project.
 - a. Provide complete cross index system set up by the Hardware Supplier, and place keys on markers and hooks in the cabinet as determined by the final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

N. **Execution**

1. **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.

IRONMONGERY (08700) (CONT'D)

N. **Execution (Cont'd)**

2. **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 for the item in question, as listed in the hardware schedule.
- b. Mount hardware units at heights indicated in “Recommended Locations for Builders Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.
- c. Install each hardware item in compliance with the manufacturer’s instructions and recommendations, using only the fasteners provided by the manufacturer.
- d. Do not install surface mounted items until finishes have been completed on the substrate. Protect all installed hardware during painting.
- e. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- f. All operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.

3. **Adjusting, Cleaning, and Demonstrating**

- a. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.
- b. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

IRONMONGERY (08700) (CONT'D)

N. **Execution (Cont'd)**

3. **Adjusting, Cleaning, and Demonstrating (Cont'd)**

- c. Clean adjacent surfaces spoiled by hardware installation.
- d. Instruct Employer's personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

4. **Field Quality Control**

- a. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the Installer, accompanied by representatives of the manufacturers of latch sets and locksets, door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:
 - 1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
 - 2. Consult with and instruct Employer's personnel in recommended additions to the maintenance procedures.
 - 3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
 - 4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

5. **Protection**

- a. Provide for the proper protection of all items of hardware until the Engineer accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

GLAZING (08800)

A. **Scope**

This Section includes the following, as indicated on the drawings:

1. Glass and glazing for aluminum doors, windows, and curtain walls
2. Mirrors

B. **Performance and Standards**

1. The Contractor shall ensure that all glazed-in materials are of adequate thickness, quality and strength to meet the required standards for wind loading.

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.

2. 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**

05010 Metal First Fixing Materials
05030 Metal Finishes
05500 Metal Fabrications
08120 Aluminium Doors and Windows
08970 Structural Glass Curtain Walls
08700 Ironmongery

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.

GLAZING (08800) (CONT'D)

D. Submittals (Cont'd)

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.

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.

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.

GLAZING (08800) (CONT'D)**F. Materials (Cont'd)****2. Glass in General**

Wherever all glass shall be double 6 mm thick tinted tempered glass + 12 mm air cavity + 6 mm thick clear tempered glass.

3. 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.

Glass mirrors shall have 3mm chamfered edges and shall be glued on plywood backing with 5mm stainless steel framing, fixed including all necessary fixing accessories.

4. 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.

GLAZING (08800) (CONT'D)**F. Materials (Cont'd)****8. Miscellaneous Glazing Materials (Cont'd)****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.

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 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 glazing compound manufacturers shall be followed.

2. Preparation

Rebates and beads must be clean immediately before glazing. Primer or 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.

GLAZING (08800) (CONT'D)**G. Workmanship (Cont'd)****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.

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 discolorations 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 on moisture proof plywood backing, including stainless steel frame grade 316L.

7. Protection and Cleaning

Protect glass from breakage after installation and indicate presence of glass by a from 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.

DIVISION 9

FINISHES

DIVISION 9

FINISHES

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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 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.

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. **Fire Protection**

The system shall 2 hour be fire rated.

CEILING SUSPENSION SYSTEMS (09120) (CONT'D)

B. Performance and Standards (Cont'd)

5. Standards

- a. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- b. ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- c. ASTM C645 - Non-Load Bearing (Axial) Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- d. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- e. ASTM C1002 - Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.

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 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.

CEILING SUSPENSION SYSTEMS (09120) (CONT'D)

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

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.

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 aluminum alloy in lieu of steel.

Wherever dissimilar metals are in contact with each other precautions shall be taken to prevent corrosion from electrolytic action.

CEILING SUSPENSION SYSTEMS (09120) (CONT'D)**F. Materials (Cont'd)****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.

4. Tying Wire

All tying wire shall be galvanized soft wire 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.

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 aluminum: 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.

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 centers 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 plaster of cement and sand to block wall or concrete surfaces, metal lath, metal furring, plaster stops, corner beads and the like as detailed on drawings.

B. Performance and Standards

1. The plaster shall have complete adhesion to the wall and shall not crack or craze.
2. Standards
 - a. ASTM C841 - Installation of Interior Lathing and Furring.
 - b. ASTM C847 - Metal Lath.
 - c. ASTM C933 - Welded Wire Lath.
 - d. ASTM C1002 - Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
 - e. ASTM C1063 - Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 - f. ASTM C91 - Masonry Cement.
 - g. ASTM C150 - Portland Cement.
 - h. ASTM C897 - Aggregate for Job-Mixed Portland Cement-Based Plasters.
 - j. ASTM C926 - Application of Portland Cement-Based Plaster.
 - k. ASTM C932 - Surface-Applied Bonding Agents for Exterior Plaster.
 - l. ASTM C1032 - Woven Wire Plaster Base.
 - m. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. Related Items

04220 Concrete Unit Masonry
09900 Painting

PORTLAND CEMENT PLASTER (09220) (CONT'D)

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.

F. **Materials**

1. **Cement**

Grey cement and white cement shall be delivered to site in sealed bags.

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 (Na₂O) (ASTM C227).
2. Ordinary Portland Cement: ASTM C150 Type I, non staining.

2. **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.

PORTLAND CEMENT PLASTER (09220) (CONT'D)**F. Materials (Cont'd)****3. Water**

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

The PH value shall be 5.5 to 8.5.

4. Lath

a. Expanded Metal Lath: Fabricate expanded metal lath from uncoated or zinc-coated (galvanized) steel sheet to produce lath for type, configuration, and other characteristics indicated below, with uncoated steel sheet painted after fabrication into lath.

1. Diamond Mesh Lath: Comply with the following requirements:

i. Configuration: Flat.

Weight: 2.5 lb/sq. yd (1.4 kg/sq. m).

2. Rib Lath: Comply with the following requirements:

i. Configuration: Flat, rib depth of not over 1/8 inch (3 mm).

Weight: 2.75 lb/sq. yd (1.5 kg/sq. m).

b. Lath Attachment Devices: Devices of material and type required by referenced standards and recommended by lath manufacturer for secure attachment of lath to framing members and of lath to lath.

5. Plaster Accessories for Portland Cement Plaster

a. Metal Corner Reinforcement: Expanded large-mesh diamond mesh lath fabricated from zinc-alloy or welded wire mesh fabricated from 0.0475-inch (1.2-mm) diameter zinc-coated (galvanized) wire and specially formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.

b. Metal Corner Beads: Small nose corner beads fabricated from zinc alloy, with expanded flanges of large-mesh diamond lath to allow full encasement by plaster.

PORTLAND CEMENT PLASTER (09220) (CONT'D)

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

5. **Plaster Accessories for Portland Cement Plaster (Cont'd)**

- c. Casing Beads: Square-edged style, with expanded flanges and removable protective tape, of the following material:

Material: Zinc-coated (galvanized) steel.

- d. Control Joints: Prefabricated, of material and type indicated below:

Material: Zinc-coated (galvanized) steel.

- e. Stop beads: standard galvanized mild steel products.

6. **Mix**

The mix shall be 1 part cement to three parts sand by volume, or as otherwise agreed with the Engineer. Plasticizer shall only be used with the approval of the Engineer.

Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

7. **Waterproofing Additive**

Waterproofing additive materials shall be an integral waterproof polymer manufactured for use as admixture and shall be approved by the Engineer.

8. **Approved Products**

Approved products shall be Premix plaster supplied by Sodap, or approved equal and with better performance.

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 block work. *Concrete surfaces shall be chipped or sand blasted.*

PORTLAND CEMENT PLASTER (09220) (CONT'D)

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

2. **Trims and Joints**

End beads shall be installed at all internal and external wall angles, and at all ceiling/wall intersections.

Beads, stops and the like shall be fixed plumb, square and true-to-line with plaster dabs at not more than 600mm centers to each mesh wing and cut edges shall be treated with one coat bituminous solution.

The lath shall be fixed to timber supports with 40mm clout nails at not more than 100mm centers along each support, 5mm hardwood pieces shall be placed between the timber support.

3. **Plaster**

Apply plaster in one key coat and two finishing coats (or more if required, but to be reinforced) to a total thickness as indicated in Breakdown of Lump Sum and Bills of Quantities.

Apply plaster to walls of shafts in one coat to a total thickness of 10mm as indicated in Breakdown of Lump Sum and Bills of Quantities.

Cross-scratch surface of first coat to provide key for second coat.

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.

Where a plaster is to be continuous across background of different types, a strip metal lath min. 300mm wide with a building paper behind shall be fixed across the junction.

PORTLAND CEMENT PLASTER (09220) (CONT'D)

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

3. **Plaster (Cont'd)**

Metal lath should be fully embedded and coated with bitumen solution at cut edges.

Apply first coat, irrigate with water after 24 hours. Apply second coat after 48 hours.

Plaster to walls and ceilings of water tanks shall be mixed with waterproofing additive as specified above.

Beads/Stops: All shall comply with the requirements of BS 6452. Generally, all edge beads/corner beads/stop beads/angle beads to external render shall be stainless steel; to suit render thickness as supplied. All beads to internal plaster shall be galvanised mild steel to suit plaster thickness.

Movement Joints: External render shall incorporate flexible external joints with sealant and compressible joint filler and bond breaker. Stainless steel render beads shall be provided to both sides of movement joint. Primary movement joints with internal plaster. 50mm gasket seal on extruded aluminium assembly.

All coats shall not be less than the thickness specified, in accordance with the Codes of Practice, shall be firmly bonded, of even and consistent appearance and be free from rippling, hollows and ridges.

Each undercoat and final coat shall be kept damp for the first 3 days by covering with polythene sheet and/or spraying with water. Drying out too rapidly shall be prevented and no forced heat drying or dehumidification shall be allowed. Work shall be carried out in the shade whenever possible. Each coat shall be allowed to dry out thoroughly to ensure that drying shrinkage is substantially complete before applying the next coat.

Sudden irregularities on the surface finish shall not occur. Permissible deviation of surface shall be 3mm when measured from underside of a 2m straightedge.

The finish shall be highly combed to receive mortar bedded tiles / wood float finish to receive adhesive bedded tiles.

Where required, engage an accredited independent testing specialist, as agreed with the Engineer, to verify that the requirements of the Contract, Codes, and manufacturer's data have been satisfied, including pull out tests. Should any test reveal defective material and/or workmanship, immediately carry out any remedial work and/or re-testing, including that of a special nature, under instruction from the Engineer.

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

1. The work shall comply with BS 5385, Code of Practice for Wall Tiling, Part 1, and Part 2 and ANSI specification A108-1990 for ceramic tile.

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

01300 Submittals
07900 Joint Sealers
09312 Ceramic Floor Tiles

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, Grout, and Adhesive

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 (If required)

Cement and sand mortar shall be as specified in 04220 Concrete Unit Masonry.

F. Materials**1. Ceramic Wall Tiles****a. Source**

Ceramic wall tiles, borders, and friezes shall be of sizes, thicknesses, and types as indicated in the schedule of finishes, with titanium dioxide active cleanliness special coating, 1st quality and 1st choice, 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. 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.

c. Sizes

Alternative size may be selected by the Engineer. Tolerances shall be in accordance with BS 6431.

d. Colours, Finish and Patterns

Colours, finish and patterns for other items shall be selected by the Engineer and shall accurately match approved samples.

CERAMIC WALL TILES (09310) (CONT'D)**F. Materials (Cont'd)**1. Ceramic Wall Tiles (Cont'd)e. Defects

The tiles shall be entirely free from defects and blemishes.

2. Adhesive

Tile adhesive shall be as recommended in writing by the manufacturer and applied strictly in accordance with printed recommendations. All tiles to be fixed using adhesive shall be bedded in accordance with the manufacturer's instructions. The adhesive for floor and wall tiles shall be a proprietary adhesive suited to the substrate and ceramic types. Adhesive shall be compatible with the background/base.

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.

Approved suppliers of grout shall be Mapei, Sodap, or approved equal and with better performance.

G. Workmanship1. 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 2mm wide minimum by means of spacers.

CERAMIC WALL TILES (09310) (CONT'D)

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

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.

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. Adhesive fixation shall be as specified in Section 04400.

b. **Adjustment**

Make any necessary adjustment to tiles within 10 minutes of fixing.

c. **Cleaning Off**

Remove surplus mortar / adhesive as soon as bedding is complete. Do not disturb tiles.

CERAMIC WALL TILES (09310) (CONT'D)

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

3. **Fixing (Cont'd)**

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 and mass 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**

01300 Submittals
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 and Adhesives**

Bedding Materials and Adhesives, cement, aggregates, etc., shall be handled and stored.

3. **Mortar (if required)**

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 (if required) (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. Ceramic floor tiles and borders shall be of sizes, thicknesses, and types as indicated in the schedule of finishes, with titanium dioxide active cleanliness special coating, 1st quality and 1st choice, to the approval of the Engineer.
- b. Each type of tile shall be obtained from a single manufacturer together with all fittings and specials relating to that type.
- c. Skirtings shall be 70 to 80mm high, unless indicated otherwise on drawings. Tiles shall be 1st quality and 1st choice, to the approval of the Engineer.
- d. All tiles shall be in accordance with European Standards as listed in Clause B2 in Section 09310.
- e. 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. Tiles used in technical and service areas shall be anti slippery heavy duty tiles.

CERAMIC FLOOR TILES (09312) (CONT'D)

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

1. **Tiles (Cont'd)**

g. **Sizes**

Alternative size may be selected by the Engineer. Tolerances shall be in accordance with BS 6431.

h. **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.

2. **Adhesive**

Tile adhesive shall be as recommended in writing by the manufacturer and applied strictly in accordance with printed recommendations. All tiles to be fixed using adhesive shall be bedded in accordance with the manufacturer's instructions. The adhesive for floor and wall tiles shall be a proprietary adhesive suited to the substrate and ceramic types. Adhesive shall be compatible with the background/base.

3. **Grout**

The grouting mortar shall be flooring grade coloured grout to the Engineer's approval.

Approved suppliers of grout shall be Mapei, Sodap, or approved equal and with better performance.

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.

CERAMIC FLOOR TILES (09312) (CONT'D)

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

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.

4. **Ceramic Tile Fixing**

Ceramic tile fixing shall be carried out in accordance with BS CP 202 and manufacturer's instructions. In general, adhesive fixation shall be as specified in Section 04400.

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 TILES (09350)**PART 1 GENERAL****1.1 Related Documents**

Drawings and general provisions of the Contract, including General Conditions, Conditions of Particular Application and Division-1 Specification Sections, apply to work of this section.

1.2 Description of Work

This section covers the work of inlaid cement tiles and terrazzo tiles for floors and bases as indicated on Drawings and required by the Contract.

- Sand cushion cementitious terrazzo
- Cement tiles

Extent of cement tiles or terrazzo tiles is shown on Drawings and schedule of finishing.

1.3 Reference Standards

Works shall be performed in strict accordance with the stipulations of the American Society for Testing and Materials (ASTM), British Standards (BS) as referenced to throughout this section, or other equivalent international standards.

1.4 Submittals

Submit the following in accordance with Conditions of the Contract and Division-1 Specification Sections:

- 1.4.1 Product Data: Materials list and manufacturer's data of each type of terrazzo components and material, include details of precast terrazzo construction of materials, dimension and profiles.
- 1.4.2 Shop drawings including complete installation details and layout plans of dividers, layout of base and border-strips. Show large scale details of terrazzo patterns.
- 1.4.3 Samples in triplicate of all units in each manufacturer's colour, texture and pattern variation, prepare samples of the thickness and from the same material to be used.
- 1.4.4 Maintenance Data: Installation and maintenance instructions of each terrazzo type.

1.5 **Related Sections**

The following section includes requirements which relate to his section:

"Concrete and Reinforced Concrete"

1.6 **Delivery, Storage and Handling**

Handle tiles in a manner not to chip edges or cause cracking to surfaces. Stacking area should be clean and level. Tiles should be stocked under a covered area or be protected from the weather by means of a tarpaulin or other suitable waterproof covering.

Tiles should also be protected against penetration of water from the ground.

Tiles should always be stacked face to face.

Cement, packaged materials for mortar and grout shall be furnished in bags displaying the manufacturer's trademark and indicating type of material.

Cement shall be dry and free of lumps and shall be stored above ground in a dry and weathertight location.

Sand shall be natural stored and handled in such a manner as to prevent intermixing with foreign matter.

PART 2 PRODUCTS

2.1 **General**

Material shall be standard grade as specified hereinafter and shall conform with the requirements of the Egyptian Standard Specifications.

Colour and pattern of tiles shall be selected by the Engineer.

Tiles shall be cast in strong metal moulds hydraulically pressed, made from cement and aggregates to the proportions and size required and shall be square, their edges and surfaces shall be at right angles to one another, all arises shall be sharp and true. Tiles shall be cured, ground, filled and polished before distribution to site.

2.2 **Inlaid Cement Tiles**

Tiles shall be composed of two layers. Concrete backing shall be composed of cement mortar 13 (by volume) cement to fine aggregate. Finish layer or facing layer shall provide a minimum wearing and shall have a thickness of the tile thickness but of a minimum thickness of 6 mm and a permissible deviation not exceeding 1 mm or 6% of the overall tile thickness and shall be composed of one part of stone powder and two parts of ordinary Portland or white or coloured cement as specified or requested by Engineer.

2.3 **Terrazzo Tiles**

The finish layer or facing layer of the tiles shall be composed of one part of crushed marble or granite chips, one part of marble powder and two parts of white or coloured cement. Marble or granite chips applied as a facing shall be selected to avoid off colour or contaminated materials and shall be crushed by a process that largely eliminates flat or sliver-like chips and accurately graded by size.

Instead of chips large fractured marble set in mortar can be used. Wide irregular joints between marble shall be filled with terrazzo matrix.

For outdoor uses, hard material such as iron grid or copper powder shall be added to the mix to improve wearing resistance. The finish layer shall have a minimum thickness of 8 mm.

Cross sections of tiles shall not show any separation between layers. Top surface shall be smooth level, free from projections and depressions, with opposite edges parallel homogeneously coloured and free of bums, hair cracking, flaking and efflorescent. Ground, grouted and reground to a fine grit finish aggregates shall be evenly distributed,

The tiles shall not be delivered until a period of at least 7 days after pressing has elapsed.

2.4 **Single Layer Terrazzo Tiles**

Shall be a single layer of terrazzo mixture over all the tile thickness, composed of well mixed crushed marble, or granite with marble powder and white coloured cement, polyacrylate modified cement, epoxy or polyester composition. Care shall be taken in mixing to get uniformity. The mixture shall be plastic and shall not flow too easily. Tiles shall be mechanically compacted and polished.

2.5 **Cement**

For manufacturing of tiles and for mortar beds cement shall be a standard brand of gray Portland cement conforming to BS 12 and ASTM 150. White cement for topping shall be as per ASTM standards.

2.6 **Sand**

Shall be clean, sharp, properly graded for the purpose, loam and silt content shall not exceed 3 %.

2.7 **Water**

Only drinking water or water whose composition is acceptable for drinking except in respect to bacteriological requirements shall be used for mixing mortar.

2.8 **Marble Chips**

Size shall be standard for mix indicated with a high abrasive-hardness value, and maximum 0.75% absorption in 24 hours, dust content shall be less than 1% by weight and containing no deleterious or foreign matter.

2.9 **Matrix Pigments**

Pure mineral or synthetic pigments, alkali resistant, colour stable, and compatible with matrix binder.

2.10 **Under Bed Bonding Mortar**

Cement sand mortar mixed with water.

2.11 **Heavy Top Divider Strips**

Straight of type indicated, of depth required and with anchoring device.

PART 3 EXECUTION**3.1 Preparation**

Prior to setting all units, inspect surfaces and arrange for the satisfactory correction of defects. Grounds, bucks, outlet and receptacle boxes, rough plumbing and other fixtures and fittings shall be in place and trenches, chases or other openings in floors properly closed.

3.2 Workmanship

Work shall be carefully laid out, providing symmetry about center lines of the areas and avoiding small, unsightly cuts. Use of thin cuts and pieces, chipped, spalled or otherwise disfigured tiles, shall not be allowed.

3.3 Setting Beds for Tiles

The mortar for setting beds shall be composed of 350 kg cement per 1 m³ of sand with sufficient mixing water. The mortar shall be spread at proper thickness of 20 mm over a bed of fine aggregate for the required levels, using screed strips. No more setting mortar shall be spread than can be covered with tile before the mortar reaches its initial set. Setting beds over membrane waterproofing shall have wire reinforcement with edges lapped at least 50 mm. Beds that have partially hardened shall not be retempered.

3.4 Setting of Tiles

The minimum period between pressing and laying, should be 21 days to 28 days.

Tiles shall be thoroughly soaked in clean water for at least one hour prior to setting and shall be applied to setting beds while damp, but without free water on the back of tile.

Spread sand on surfaces to receive sand-cushion

Tiles shall be layed with alignment level true to dimension and accurately set firmly pressed and tamped into full mortar beds with well fitted joints in true planes, graded or level and neatly cut and fitted closely against abutting work.

When hit after setting tiles shall give a solid firm sound. if a hollow sound is produced tiles and motor layer shall be removed and replaced.

Intersections and returns shall be accurately formed and cuts rubbed smooth with fine stone. Tiles when cut shall not be less than half their original size. Cut edges shall be set against fixtures or other tile with at least a 1 mm joint.

For terrazzo tiles install divider strips where required. Joints shall not exceed 2 mm and for cement tiles laid on roof joints shall be staggered and clearance shall not be less than 5 mm.

Mortar shall not be allowed through joints.

3.5 **Grouting**

Allow at least 48 hours before grouting.

All tiling, shall be grouted up on completion with neat cement.

Thoroughly wash out floor tile Joints and saturate with clean water before grouting. Grout joints after setting bed is dry with grey, white or coloured grouting cement mixed with water to a creamy consistency and thoroughly forced into all joints to fill entire depth.

Finish grout shall be uniform in color, smooth and without voids pin holes or depressions.

Any surplus grout shall be cleaned off the face of the tiling and surrounding surfaces immediately and all tiling shall be carefully cleaned off

Cure grout and finish tile.

3.6 **Bases**

Bases for roof cement tiles shall be an inclined tile to comply with height indicated on Drawings and to cover the damp-proofing membrane.

Bases shall be a tile or part of tiles cut by the use of suitable cutting saw to comply with heights indicated on Drawings.

The proceeding pieces shall be matching and of sharp edges, and shall not be chipped, spalled or otherwise disfigured.

Special terrazzo base units shall have a bull nose top edge and a cove end for transition from wall to horizontal floor tiles and shall be produced in the same way using the same mix as for tiles.

Adhesive material or cement mortar grout shall be used to install bases in place, The cement mortar grout shall solidly fill any space between backing walls and bases.

3.7 **Cleaning**

After grouting has sufficiently set or hardened, tile surface shall be cleaned and traces of cement or dust accumulations and foreign matter shall be completely removed.

A layer of clean sand shall be spread over tile floor and shall be kept wet with water for a period of ten days for curing and shall be left or replaced by a non-staining sawdust to protect tile floor surface while other works are being done till the Engineer's order to clear and clean the floor surface.

The floor should be thoroughly scrubbed with soap and water.

The surface of terrazzo tiles shall be polished on completion to the Engineer's satisfaction.

Large areas shall be wet polished by means of approved machines using carborundum wheel.

Any surface too small for convenient machine polishing may be polished by hand using carborundum stone and water.

On completion of final polishing, the paving should be thoroughly clean and left to dry naturally.

3.8 **Protection**

Provide tile protection whenever required. Material likely to stain or deface tile shall not be used. Close grouted floors and stairs to traffic completely for 24 hours after installation, thereafter, permit traffic on tiled floors only over protective covering of cardboard or equivalent.

SUSPENDED CEILING SYSTEMS (09515)

A. **Scope**

1. This section covers suspended ceilings consisting of gypsum boards and bulkheads, gypsum fibrous false ceilings, lighting coves, cornices, friezes, bulkheads, arches, strips and panels complete with suspension system and all necessary trims and accessories as indicated on drawings and schedules.

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.

NFPA material; class A or B.

C. **Related Items**

01300 Submittals
05010 Metal First Fixing Materials
09120 Ceiling Suspension Systems
09900 Painting

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.

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.

SUSPENDED CEILING SYSTEMS (09515) (CONT'D)

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

2. **Shop Drawings (Cont'd)**

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 Ceilings**

All gypsum board shall be water and moisture resistant 12.7mm thick anchored to suspension system as shown on the drawings and schedules with no apparent joints as shown on the drawings and schedules.

The board shall be plain gypsum plasterboard with a seamless surface produced by the use of tapered edge boards, taped and filled.

Gypsum Board and Related Products shall be Class A or B as per NFPA.

SUSPENDED CEILING SYSTEMS (09515) (CONT'D)**F. Materials (Cont'd)****1. Gypsum Board Suspended Ceilings (Cont'd)****Accessories (Steel Framing and Furring, Grid Suspension Assemblies, etc...)**

Provide and install aluminium profile edges to all gypsum suspended ceilings whether shown on drawings or not. All accessories shall be as recommended by gypsum board manufacturer, to the approval of the Engineer.

Provide and install bulkheads, cornices, and other decorative items wherever required even if they are not shown on the drawings. Provide shop drawings to the approval of the Engineer.

2. Fibrous Gypsum Suspended Ceilings

A. Fibrous Gypsum Fabrications: High density gypsum reinforced with continuous filament glass fiber mat and structural reinforcing as required.

Glass Content: 5 to 6 percent by weight.

Density: 1650 to 1795 kg/m³.

Shell Thickness: 5 to 10 mm, nominal.

Cast Boards: 20mm thick or as otherwise indicated.

Flame Spread Index: 0, when tested in accordance with ASTM E 84.

Flexural Strength: 22 to 27.5 MPa, when tested in accordance with ASTM D 790.

Modulus of Elasticity: 1450 to 1515 MPa, when tested in accordance with ASTM D 790.

Tensile Strength: 8.3 to 9.6 MPa, when tested in accordance with ASTM D 638.

Impact Strength: 13 to 14.4 J/sq mm, when tested in accordance with ASTM D 256.

Hardness: M 72, when tested in accordance with ASTM D 785, Rockwell.

Variation from Dimensions Indicated on Drawings: Plus and minus 3 mm, maximum.

Variation from Plane Along Edge or Surface: Plus and minus 1.5 mm in 300 mm, maximum.

Outside Corner Radius: 1.5 to 3 mm.

Draft Angle: 3 degrees, minimum, on returns, setbacks, reveals, and grooves.

Items Too Large or Heavy to be Adhesively Installed: Provide concealed anchorage points for plaster type wire anchors.

SUSPENDED CEILING SYSTEMS (09515) (CONT'D)

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

3. **Gypsum Cornices, Roses, Friezes, and other Decorative Items**

Cornices, lighting coves, and decorative items shall be formulated to shapes as shown on drawings. Cornices for light coves shall be smooth clean finish from all faces. All moulds shall be submitted for approval before production of gypsum moulds.

4. **Access to Ceiling Void**

Provide access panels to all suspended ceilings. 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. Access panels shall be installed as needed and as required by the Engineer.

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. **Manufacturer's Recommendations**

The manufacturer's instructions and recommendations shall be followed for all products.

3. **Suspension**

The method of fixing hangers to the structural soffit shall be agreed with the Engineer.

4. **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.

5. **Gypsum Board Suspended Ceiling Construction**

Where gypsum board ceilings are shown on the drawings they shall consist of one layer of gypsum board jointed and finished as specified for partitions and dry lining, screwed to metal ceiling section.

At the perimeter of the ceiling the sections shall be housed into perimeter channel and secured in location by self-tapping screws. The perimeter channel shall be fixed by self-tapping screws to the vertical studs of partitions, or plugged and screwed to concrete or block work walls.

Short lengths of section shall be used to wedge the sections into the perimeter channel. Vertical support to ceiling shall be by galvanized mild steel hangers fixed to concrete soffits by approved anchor bolts.

SUSPENDED CEILING SYSTEMS (09515) (CONT'D)

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

6. **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.

7. **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.

8. **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.

9. **Cleaning, Protection and Patching**

a. Be responsible for cutting and patching of defects appearing in the suspended ceiling systems 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.

10. **Defects**

The making good of defects shall be carried out to the entire satisfaction of the Engineer.

SUSPENDED CEILING SYSTEMS (09515) (CONT'D)

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

11. **Decoration**

After joint treatment has dried decoration, including any decorator's preparatory work, shall follow with the minimum delay.

12. **Texture**

Primer: of type recommended by texture finish manufacturer to the approval of the Engineer.

Paint: Emulsion or oil paint of type recommended by texture finish manufacturer to the approval of the Engineer.

INTERIOR STONEMWORK (09615)**A. Scope**

This section specifies stone for but not limited to the following: floors, walls, skirtings, thresholds, sills, treads and risers, patterns, strips, architraves, frames, borders, columns with base and capital, mouldings, freizes, counters, vanity units and tops, shower trays, bathtubs cover and fascia, 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.

Stone shall meet requirements of ASTM C-503 for group A marble.

C. Quality Assurance

All stone shall be provided from a single source from a single quarry to ensure consistency of quality and colour.

D. Related Items

01300 Submittals
04100 Masonry Mortar
04400 Stone
05010 Metal First Fixing Materials.

E. Submittals**1. Sample of Stone**

The Contractor shall provide an adequate number of samples of the specified stone, 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.

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.

INTERIOR STONEMWORK (09615) (CONT'D)

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

2. **Shop Drawings (Cont'd)**

- 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. **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 not 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.
- 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 stones to distribute weight evenly and to prevent breakage or cracking of stones. Protect stored stone from weather with waterproof nonstaining covers or enclosures, but allow air to circulate around stone.
- d. 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.

INTERIOR STONEMWORK (09615) (CONT'D)**G. 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 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.
- e. Stainless steel used for fixations of mechanically fixed stone cladding and for stainless steel floor separations shall be Grade 316L and shall be as specified in sections 04400 and 05010.
- f. Stone shall be cut to size and generally be 20mm thick unless shown otherwise on drawings or indicated otherwise in Breakdown of Lump Sum and Bills of Quantities.
- g. Provide stone to match project samples and job mock-up.
- h. Stone used for sills, copings, trims, etc... shall be cut to sizes and shaped as detailed on the drawings.

INTERIOR STONEMWORK (09615) (CONT'D)**G. Materials (Cont'd)****3. Characteristics of Stone**

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

ASTM C-503 Physical Test Requirements

Physical Properties	Test Requirement	Test Method
Absorption by Weight, Max. %	0.20	C97
Density, min., lb./cu.ft.	162	C97
Compressive Strength, min., PSI	7500	C170
Modulus of Rupture, min., PSI	1000	C99
Abrasion Resistance, min., hardness	10	C241
Flexural Strength, min., PSI	1000	C880
Coefficient of Friction	.60	C108-89

The actual stone 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.

4. Sizes

Sizes shall be as shown on drawings and schedules. Minimum thickness is indicated in Breakdown of Lump Sum and Bills of Quantities. Sizes shall be to the approval of the Engineer.

5. Finish

Unless shown otherwise on drawings or indicated otherwise in Breakdown of Lump Sum and Bills of Quantities, in general all stone used for walls, thresholds, sills, skirtings, treads and risers, etc... shall be pre-polished, and stone used for floors shall be polished after installation.

6. Bedding Mortar

Refer to section 09420.

7. Grout

The grout shall be to an approved colour, from an approved manufacturer.

INTERIOR STONEMWORK (09615) (CONT'D)8. Samples at Employer's Offices

The Tenderers shall inspect the various stone and marble samples available at Employer's offices before submitting their Tender, and shall sign on them. The successful Tenderer shall ensure that samples he submits during construction do match with those available at Employer's offices, and / or approved equal and with better performance. Not inspecting these samples shall not relieve the Contractor from his liabilities in this regard, and no claims of whatsoever nature shall be entertained.

9. Adhesive

Tile adhesive shall be as recommended in writing by the manufacturer and applied strictly in accordance with printed recommendations. All tiles to be fixed using adhesive shall be bedded in accordance with the manufacturer's instructions. The adhesive for floor slabs and wall tiles shall be a proprietary adhesive suited to the substrate and stone types. Adhesive shall be compatible with the background/base.

H. Workmanship1. 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.

3. Stone Generally

a. All stone 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. Floor Thickness

The overall thickness from structural concrete slab to finished surface of stone tile on floors shall be as indicated on drawings.

INTERIOR STONEMWORK (09615) (CONT'D)

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

5. **Mortar Bed, Finishing and Polishing**

Refer to section 09420. For mechanically fixed stone cladding and stone fixed using adhesive, refer to section 04400.

6. **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 stone with which it is used.

7. **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.

8. **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.

SPECIAL COATINGS (09800)

A. **Scope**

This section specifies, but not limited to coating to resist ‘dusting’ of the concrete surfaces and to provide a non-slip finish in locations as indicated on drawings.

This section should be read in conjunction with section Painting 09900.

Installation of waterproof polyurethane coating on surfaces indicated on drawings, shall include preparation of existing and repaired concrete surfaces, sealing of cracks and joints, and application of coating system.

Product provided by this Section is a system of compatible polyurethane coatings designed to create a seamless waterproofing membrane and suitable for use as a wearing surface on vehicular traffic decks.

B. **Performance and Standards**

ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

FS TT-C-535 - Coating, Epoxy, Two-Component, for Interior Use on Metal, Wood, Wallboard, Painted Surfaces, Concrete and Masonry.

ASTM C 957 High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface.

Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the coating system manufacturer.

Regulatory Requirements: Comply with applicable codes, regulations, ordinances and laws regarding use and application of coating systems that contain volatile organic compounds (VOC).

Pre-Application Conference: Prior to beginning work, convene a conference to review conditions, installation procedures, schedules and coordination with other work.

C. **Related Items**

03300 Cast-In-Place Concrete
09900 Painting

SPECIAL COATINGS (09800) (CONT'D)**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 meters 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.

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

Product provided by this Section is a system of compatible polyurethane deck coatings designed to create a seamless waterproofing membrane and suitable for use as a wearing surface on vehicular traffic decks.

Base Membrane: Shall be single-component, VOC compliant, high adhesion, liquid polyurethane membrane and shall meet or exceed the following typical performance properties:

Property	Typical Value	ASTM Method
Composition	Aromatic Urethane	
Solids by Weight	85%	C 1250
Hardness, Shore A	63	D
	2240	
Tensile Strength	850 PSI	D 412
Ultimate Elongation	625%	D 412
Tear Resistance	140 lb/in	D 624
Adhesion to Concrete	23 PLI	D 903
Low Temp. Flexibility	-65°F	D 522

SPECIAL COATINGS (09800) (CONT'D)**F. Materials (Cont'd)**

Elastomeric Membrane: Shall be single component, VOC compliant, high tensile strength, liquid applied elastomeric polyurethane and shall meet or exceed the following typical performance properties:

Property	Typical Value	ASTM Method
Composition	Aromatic Urethane	
Solids by Weight	80%	C 1250
Hardness, Shore A	82	D 2240
Tensile Strength	2000 PSI	D 412
Ultimate Elongation	425%	D 412
Tear Resistance, Die C	300 lb/in.	D 624
Low Temp. Flexibility	-650F	D 522

Traffic-Resistant Top Coat to floors and walls up to 1000mm high above FFL: Shall be single component, VOC compliant, high tensile strength, abrasion-resistant and weather-resistant aliphatic elastomeric polyurethane and shall meet or exceed the following typical performance properties:

Property	Typical Value	ASTM Method
Composition	Aliphatic Urethane	
Solids by Weight	72%	C 1250
Hardness, Shore A	91	D 2240
Tensile Strength	3200 PSI	D 412
Ultimate Elongation	190%	D 412
Tear Resistance, Die C	300 lb/in.	D 624
Low Temp. Flexibility	Pass	C 957
And Crack Bridging *		
Weather Resistance	No Chalking at 2000 hrs.	G 53
Water Permeability (system)	< 1.0 Perm	E 96 B
Abrasion Resistance (system)	< 50 mg.	C 501
Fire Resistance (system)	Class A	U.L. 790

Floor coating in parking shall be to be polyurethane heavy duty, total thickness 93mils (2.4mm). Paint to walls in parking shall be 1000mm high polyurethane coating light duty.

SPECIAL COATINGS (09800) (CONT'D)

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

ACCESSORY PRODUCTS:

- A. Surface Primer: Shall be component epoxy primer or as recommended by manufacturer for each surface encountered.
- B. Detail Coat: Shall be single-component, moisture cured polyurethane membrane.
- C. Aggregate: Shall be clean, dry 16 to 30 mesh aggregate as approved by the coating manufacturer.
- D. Sealants: Shall be one component or two component Polyurethane Sealant.
- E. Backing Rod: Shall be closed-cell polyethylene foam rod.
- F. Flexible Flashing: Shall be as recommended and supplied by coating manufacturer.
- G. Apply fluorescent strip of 100mm wide to walls of parking and ramps.
- H. Colours shall be to the approval of the Engineer.

G. **Workmanship**

GENERAL

Do not apply coating materials if temperature is less than 40 degrees F. or if precipitation is imminent.

Coordinate coating work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of coatings. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the coating to cure adequately.

SPECIAL COATINGS (09800) (CONT'D)

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

GENERAL (Cont'd)

Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by coating operations.

Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.

Take care to keep vapors from entering occupied structures. Turn off intake blowers, seal doors, vents and other openings that could allow vapors to enter.

Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated.

Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

The application shall be in accordance with the manufacturer's instructions.

INSPECTION:

A. Before any work is started the applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the Engineer shall be notified in writing and corrections made.

B. Condition of Concrete Surfaces:

1. The concrete surfaces shall be of sound structural grade (minimum of 3500 PSI compressive strength for vehicular decks), and shall have a steel-troweled followed by a fine broom finish, free of fins, ridges, voids or entrained air holes.
2. Concrete shall be cured by water curing method.
3. Concrete shall be cured at least 28 days and shall be sloped for proper drainage.
4. Saw-cut control joints and/or expansion joints shall have been properly installed at strategic points throughout the field of the deck to control cracking caused by deflection and shrinkage.
5. Any required crickets or drains should be installed at the time the main deck is poured. Deck should be monolithic.

SPECIAL COATINGS (09800) (CONT'D)

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

INSPECTION: (Cont'd)

6. Voids, rock pockets and excessively rough surfaces shall be repaired with approved non-shrink grout or ground to match the unrepaired areas.
7. When metal decking is used as the concrete form, it shall be of the ventilated type.
8. All concrete decks poured over precast "T's", planks or slabs, shall have control joints placed directly over all corresponding joints or openings in the precast units.

SURFACE PREPARATION:

A. Concrete Surfaces:

1. The concrete surface must be thoroughly clean, dry and free from any surface contaminants or cleaning residue. Acceptable methods of cleaning are vacuum shotblasting, sandblasting, acid etching or mechanical grinding followed by the complete and thorough removal of any residue.
2. Install a 1" face, 45 degree cant of polyurethane sealant at all angle changes including projections through the deck, walls, curbs, bumpers, etc.
3. All cracks over 1/16" in width and all moving cracks under 1/16" in width shall be saw cut to 1/4" minimum in width and depth. Saw cut a 1/4" by 1/4" kerf around drain flanges. Clean, prime and fill saw cuts flush with polyurethane sealant.
4. All moving cracks over 1/16" wide and all expansion joints less than 1" wide shall be cleaned, primed, fitted with a backing rod and caulked with polyurethane sealant.
5. Allow all sealant to cure thoroughly before applying coating.
6. Prime all areas to receive detail coats following priming instructions. Extend primer 2" beyond area to receive detail coat to allow primer tie-in during coating application.
7. Apply a 6" wide stripe-coat 30 mils thick centered over all sealed cracks, hairline cracks, sealant cants, control and cold joints, and expansion joints less than 1" wide.

- B. All required metal and neoprene flashings shall be installed at this time. Apply a stripe coat Detail Coat, 30 mils thick, 6" wide, centered over all transitions from concrete to metal flashings and reinforce with Reinforcing Fabric. Allow the stripe coat to cure over night (16 hours minimum).

SPECIAL COATINGS (09800) (CONT'D)

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

APPLICATION:

Comply with the manufacturer's published instructions for Installation of waterproof polyurethane coating including proper substrate preparation and jobsite considerations.

A. Priming:

1. Stir each side separately to ensure that no separation has occurred then mix all of Part A with all of Part B. Use a mixing paddle in a slow speed drill motor. Mix 2 to 3 minutes until a homogenous blend is achieved. Allow 15 to 30 minute induction period before applying.
2. Apply primer at a rate of 400 square feet per gallon. Avoid puddles or ponding the primer and do not apply primer over stripe coats.
3. Allow primer to dry for 1 hour minimum, 8 hours maximum. Primer is sufficiently dry when it is somewhat tacky but will not transfer when touched. In the event coating is not applied within the maximum time, reprime.

B. Base Membrane: Apply in one uniform coat at the rate of one gallon minimum per 50 square feet or as needed in order to obtain a minimum thickness of 32 wet mils. Allow the base membrane to cure 16 to 48 hours.

C. Elastomeric Membrane:

Standard Traffic Areas: Apply in one uniform coat at the rate of one gallon minimum per 100 square feet or as needed in order to obtain a minimum thickness of 16 wet mils. Immediately broadcast 16 mesh aggregate into the wet material at a rate of 10 to 12 lbs. per 100 square feet and backroll. Allow the membrane to cure 16 to 48 hours.

D. Top Coat: Apply in one uniform coat at the rate of one gallon minimum per 100 square feet or as needed in order to obtain a minimum thickness of 16 wet mils. Backroll for uniformity.

E. Traffic on coated surface: The completed coating system shall not be subject to any traffic during the first 24 hours after application is complete nor to any vehicular traffic during the first 48 hours after application of the final coat. Cool temperatures will significantly increase the required cure time. If the work of the applicator has not been approved by the prime contractor during the first 48 hours after application is complete, then there shall be no traffic of any type allowed until such acceptance and approval is given.

SPECIAL COATINGS (09800) (CONT'D)

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

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 coating system. Contact manufacturer for sample documents, including all limitations.

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.

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

05030 Metal Finishes
06400 Architectural Woodwork
08110 Steel Doors
08200 Steel Access Panels
08210 Wood Doors
09220 Portland Cement Plaster
09515 Suspended Ceiling Systems

PAINTING (09900) (CONT'D)

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.

PAINTING (09900) (CONT'D)**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.

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.

3. Gloss/Semi-Gloss Paint

a. Long - oil based alkyd enamel paint, undercoats and finishing coats to BS 2524.

b. Polyurethane based paint, undercoat and finishing coat.

c. Titanium Dioxide paint, undercoat and finishing coat.

d. Titanlux coating to steel balustrades where indicated on drawings.

PAINTING (09900) (CONT'D)

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

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.

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.

PAINTING (09900) (CONT'D)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", "TouPret" or approved equal and with better performance, to the approval of the Engineer.

5. Acrylic Paint

Acrylic enamel paint, matt and semi-gloss as directed by the Engineer, vapor permeable type, clear, ozone resistant, non-yellowing.

G. Workmanship1. PreparationA 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.

PAINTING (09900) (CONT'D)**G. Workmanship (Cont'd)**

- 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 four (4) coats of putty to concrete and plaster surfaces and to gypsum boards and fibrous suspended ceilings, unless indicated otherwise in Breakdown of Lump Sum and Bills of Quantities.

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 scale 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 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 above. Items which must remain in position during painting must be adequately and carefully taped.

PAINTING (09900) (CONT'D)

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.

PAINTING (09900) (CONT'D)**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 Breakdown of Lump Sum and Bills of Quantities.
2. Ferrous Metal
 - a. Shop-Primed
 - i. Undercoat: Spray Enamel Undercoater (2 No.)
 - ii. Putty (2 No.)
 - iii. Finishing Coats: Spray Alkyd Eggshell Enamel (3 No.)
 - iv. Titanlux painting to metal balustrades where indicated on drawings
 - b. Galvanized
 - i. Prime Coat: Spray Zinc Dust Primer (1 No.)
 - ii. Putty (2 No.)
 - iii. Undercoat: Spray Enamel Undercoater (2 No.)
 - iv. Finishing Coats: Spray Alkyd Eggshell Enamel (3 No.)
 - c. Steel surfaces
 - i. Prime Coat: Zinc Phosphate Primer (2 No.)
 - ii. Putty : Oil based (where necessary)
 - iii. Finishing Coats: Oil based glossy (2 No.)
 - iv. Final Finishing Coats: Oil based semi-glossy (1 No.)
3. Cement Plaster and Gypsum Surfaces
 - a. Enamel Finish (oil, emulsion, or acrylic)
 - i. Prime Sealer Coat: Latex Primer (1 No. coat)
 - ii. Putty Filler With Smoothing: Oil based (2 No. coats)
 - iii. Undercoat: Enamel Undercoater (1 No. coat)
 - iv. Putty Filler With Smoothing: Oil based (2 No. coats)
 - v. Undercoat: Enamel Undercoater (1 No. coat)
 - vi. Putty Filler With Smoothing: Oil based (Additional coats may be required according to conditions after inspection, including repair where needed)
 - vii. Finishing coats: Alkyd Eggshell Enamel matt (3 No. coats)

PAINTING (09900) (CONT'D)**H. Schedule of Interior Painting (Cont'd)****3. Cement Plaster and Gypsum Surfaces (Cont'd)****b. Flat Finish (oil, emulsion, or acrylic)**

- i. Prime Sealer Coat: Latex Primer (1 No. coat)
- ii. Putty Filler With Smoothing: Oil based (2 No. coats)
- iii. Undercoat: Latex Undercoater (1 No. coat)
- iv. Putty Filler With Smoothing: Oil based (2 No. coats)
- v. Undercoat: Latex Undercoater (1 No. coat)
- vi. Putty Filler With Smoothing: Oil based (Additional coats may be required according to conditions after inspection, including repair where needed)
- vii. Finishing coats: Latex Flat (3 No. coats)

4. Wood**a. Shop-Primed**

- i. Undercoat: Enamel Undercoater (1 No.)
- ii. Finishing Coats: Varnish (6 No.)

b. Plywood and Softwood and doors in cellars areas

- i. Prime Coat: Alkyd Primer Sealer (1 No.)
- ii. Putty (2 No.)
- iii. Undercoat: Enamel Undercoater (2 No.)
- iv. Finishing Coats: Alkyd Eggshell Enamel (3 No.)

5. Polyurethane paint to wood surfaces

- a. Undercoater: Polyurethane undercoat, white, cross applied (5 No.) minimum.
- b. Finishing coats: Polyurethane semi-gloss finish, cross applied (2 No.) minimum.

6. Nitro cellulose paint to massive and veneered wood surfaces

- a. Undercoater: Nitrocellulose undercoater, clear, cross applied (5 No.) minimum.
- b. Finishing coats: Polyurethane top coater, colour to the approval of the Engineer, cross applied (2 No.) minimum.

PAINTING (09900) (CONT'D)

J. Schedule of Exterior Painting

1. Rubberized Paint

- i. Prime Coat: Latex Primer
- ii. Undercoat: Enamel Undercoater (1 No.)
- iv. Finishing coats: Rubberized Enamel (2 No.)

2. Exterior Wood Surfaces

- a. Wood preservative: impregnated stain based on solvent-based one component synthetic resins (2 No.)
- b. Sealer: Transparent thixotropic filling sealer based on solvent based one component synthetic resins (2 No.)
- a. Finishing coats: transparent thixotropic top coat based on solvent based one component synthetic resins, semi glossy (2 No.).

DIVISION 10

SPECIALTIES

DIVISION 10
SPECIALTIES

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CORNER GUARDS (10260)

A. **Scope**

1. Product Data: Manufacturer's printed instructions.
 - a. Note material, thicknesses and gauges, finishes, locations, and method of connections.
2. Color chips: Manufacturer's up-to-date full range of standard colors.

B. **Performance and Standards**

Comply with applicable codes and regulations and to the direction of the Engineer.

C. **Related Items**

01300 Submittals
Division 6 Wood and Plastics

D. **Submittals**

1. **Product Data**

Submit copies of manufacturer's materials specified herein for approval, and obtain approval before materials are delivered to the site.

2. **Samples**

Submit samples of materials specified herein for approval, and obtain approval before materials are delivered to the site.

E. **Product Handling**

1. Deliver materials specified herein in manufacturer's unopened containers, with manufacturer's name and point of origin on each container.
2. Handle and store in accordance with manufacturer's instructions and recommendations.

WALL AND CORNER GUARDS (10260) (CONT'D)

E. **Product Handling (Cont'd)**

3. **Warranty**

- a. The manufacturer shall warrant all work performed under these specifications to be free of defects for a period of one year.
- b. Any materials found to be defective within this period will be replaced at no cost to the owner. This warranty shall not include replacements required by Acts of God, war, vandalism, flood, fire, calamity or deliberate abuse or misuse of the equipment.

F. **Materials**

1. **Manufacturer and Type**

- a. Corner guards: 51 x 51mm severe duty vinyl corner guards, mechanically fixed with continuous aluminium wall bracket retainer / support with top and bottom end caps, surface mounted corner guards; in color selected by the Engineer as manufactured by Pawling or approved equal.

G. **Workmanship**

1. **Installation**

- a. Install wall and corner guards in compliance with manufacturer's instructions.
- b. Install wall guard at height indicated in drawings, after wall finish has been applied.
- c. Set corner guard at top of base and adhere to wall after wall finish has been applied.

SIGNAGE (10400)

A. **Scope**

The work of this section shall include, but not be limited to, the installation of 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**

01300 Submittals
05010 Metal First Fixing Materials
05030 Metal Finishes

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 as listed in the List of Materials / Manufacturers Booklet, or approved equal and with better performance.

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.

a. Aluminium

- i. Aluminium plate 2mm thick with 3 MEG reflective sheet-in background and text, double sided suspended or wall mounted, 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 heliare welded in conformance with the American Welding Society and the Aluminium Associations specifications.
- iv. Sizes and types shall be as indicated in the Breakdown of Lump Sum and Bills of Quantities

b. Stainless Steel

- i. Stainless steel plate 5mm thick with silk print, angles, channels, extrusions and other structural items shall be fabricated from stainless steel grade 316L as required for applicable function and use.
- ii. All stainless steel 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 heliare welded in conformance with sections 05010 and 05030.
- iv. Sizes and types shall be as indicated in the Breakdown of Lump Sum and Bills of Quantities

SIGNAGE (10400) (CONT'D)

F. Materials (Cont'd)

2. Materials (Cont'd)

c. Fasteners and Hardware

- i. Hardware shall be non-corrosive type and shall be non-conductive and/or insulated when joining non compatible material.

d. 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 material similar to sign material to suit sign panel construction and mounting conditions indicated. Factory finished brackets in colour matching background colour of sign panel, unless otherwise indicated.
- 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.
- v. 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.

e. 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.

SIGNAGE (10400) (CONT'D)

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

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

e. **Installation (Cont'd)**

- 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.

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.

SIGNAGE (10400) (CONT'D)

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

3. **Installation (Cont'd)**

- 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.

SECTION 10850 - TRAFFIC CONTROL EQUIPMENT

PART – 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Automatic barrier gates.

1.03 REFERENCES

- A. ASTM A 153 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A 666 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
- D. ASTM A 1008 - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- E. ASTM B 209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- F. ASTM B 221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.04 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Provide parking control equipment that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For parking control equipment to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Source Limitations: Obtain parking control equipment through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 COORDINATION

- A. Coordinate installation of anchorages for parking control equipment. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Electrical System Roughing-in: Coordinate layout and installation of parking control equipment with connections to power supplies and security access control system.

PART 2 - PRODUCTS

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
1. Sheet: **ASTM B 209** (ASTM B 209M).
 2. Extruded Shapes: **ASTM B 221** (ASTM B 221M).
- B. Anchorages: Anchor bolts; hot-dip galvanized according to ASTM A 153/A 153M.

2.03 AUTOMATIC BARRIER GATES

- A. General: Provide UL-approved parking control device consisting of operator and controller housed in cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate arm height in down position of not more than 889 mm to prevent even small vehicles from passing under gate arm.
1. Controller: Factory-sealed, solid-state, plug-in type, with galvanized steel box for wiring connections. Equip unit with the following features:
 - a. Capable of storing successive inputs and sequentially processing each one.
 - b. Automatic instant-reversing mechanism that stops downward motion of gate arm if arm strikes an object and that immediately returns arm to upward position. Include a 0- to 60-second variable-time reset device.
 - c. On-off power supply switch.
 - d. Automatic-manual switch.
 - e. Differential counter.
 - f. Directional arming logic.
 - g. RS-422 communication port.
 - h. Broken gate-arm monitoring.
 - i. Programmable automatic timer.
 - j. Internal resettable counters.
 - k. Thermal-overload protection with manual reset.
 - l. Plug-in connectors for three vehicle loop detectors.
 - m. Thermostatically controlled heater with on-off-auto switch.
 - n. Diagnostic mode for on-site testing, with LEDs for inputs and outputs.
 - o. Automatic and continuous testing of inputs and outputs.
 - p. Switch to test motor and limit switches or raise gate arm manually.
 - q. Single, 115-V ac grounded power receptacle.
 2. Communicating-Type Controller:

-
- a. Real-time communication of lane counts, status messages, and execute commands.
 - b. Monitor illegal entries and exits, tailgates, tickets, monthlies, and backouts.
 - c. Status messages for gate up too long, backouts, ticket in chute, and gate-arm rebound.
 - d. Communication commands for resetting loops, turning FULL signs on/off, raising and lowering gate arm, and disabling card readers.
- B. Cabinets: Fabricated from metal sheet with seams welded and ground smooth; approximately 381 mm square by 1016 mm tall. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
1. Material: 2.8-mm thick, stainless-steel sheet.
 - a. Finish cabinet with No. 4 finish.
- C. Straight Gate Arm with Counterbalance: 9-by-140-mm actual size aluminum with steel counterweights; with painted finish and black diagonal stripes on traffic-side face. Provide mounting flange with breakaway feature to ensure clean break if arm is struck by vehicle.
1. Length: As indicated on Drawings.
- D. Operator: 1/2 hp; 50 Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.
- E. Accessories:
1. Low-voltage red warning lights that illuminate when gate is in down position.
 2. Gate-arm tip support.

2.04 ACCESS CONTROL UNITS

- A. Card Reader Access Unit: Access control system that activates barrier gates and functions only when authorized card is presented. Fabricate housing from welded cold-rolled steel sheet with weatherproof front access panel equipped with flush-mounted lock and two keys. Finish units with manufacturer's standard baked-enamel coating system. Provide face-lighted unit fully visible at night.
1. System: Programmable, multiple-code capability permitting validating or voiding of individual cards.
 2. Reader: Insertion type for magnetic-stripe cards.

3. Operation: Stand alone.
4. Features: Timed antipassback.
5. Mounting: As indicated on Drawings.
6. Cards: Provide required number of cards.

2.05 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Aluminum Finishes: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 1. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: thermosetting, modified-acrylic enamel primer/topcoat system). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
- C. Galvanized Steel Finishes: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition. Remove mill scale and rust, if present, from uncoated steel.
 1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking.
- D. Stainless-Steel Finishes: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
 1. Bright, Directional Polish: No. 4 finish.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.

- B. Examine roughing-in for electrical systems to verify actual locations of connections before parking control equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Concrete Bases for Traffic Controllers: Place cast-in-place concrete, made of not less than 3000-psi (20.7-MPa) compressive strength (28 days), dimensioned and reinforced according to traffic controller manufacturer's written instructions and as indicated on Drawings.

3.03 INSTALLATION

- A. Automatic Barrier Gates: Anchor cabinets to concrete bases with anchor bolts or expansion anchors and mount barrier-gate arms.
- B. Vehicle Loop Detectors: Cut grooves in pavement and bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.
- C. Traffic Controllers: Anchor controllers to recessed concrete bases with anchor bolts or expansion anchors.
- D. Ground equipment according to Division 16 Section "Grounding and Bonding."
- E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Each electrical test and visual and mechanical inspection shall be stated in NETA ATS, Section 7.15 and compliance with test parameters shall be certified.
 - 2. Operational Test: After electrical circuitry has been energized, units shall be started to confirm proper motor rotation and unit operation.
 - 3. Controls and safeties shall be tested and adjusted. Report any damaged and malfunctioning controls and equipment.

- C. Remove and replace parking control equipment where test results indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 ADJUSTING AND CLEANING

- A. Adjust parking control equipment to operate smoothly, easily, and properly. Confirm that locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware, gate operators, and other moving parts.
- C. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.
- D. Remove barrier-gate arms during the construction period to prevent damage, and install them immediately before Substantial Completion.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the Employer's maintenance personnel to adjust, operate, and maintain parking control equipment. Refer to Division 1 Section "Contract Closeout."

3.07 TESTING AND COMMISSIONING, TRAFFIC SIGNALS

- A. As soon as the work at any one intersection is completed, the Contractor shall notify the Engineer to test and commission the system.
- B. All testing instruments and tools like oscillograms, meters, recorders, etc., required and indicated as necessary by the manufacturer of the testing of the equipment shall be provided free of charge by the Contractor.
- C. After the system has been tested successfully, the Contractor shall commission the installation in the presence of the Engineer and demonstrate that the system operates as required by the specification.

10870 FLAGPOLES**PART 1 - GENERAL**

- 1.1 **DESCRIPTION**: This section covers engineering, fabricating, furnishing, and installing Flagpoles where shown on the drawings, where required and as specified herein.
- 1.2 **APPLICABLE CODES AND STANDARDS**: The codes and standards applicable to only a portion of the work specified in this section are referenced in the relevant paragraphs.
- 1.3 **SUBMITTALS**: The following submittals are required.
- A. **Details Drawings and/or Shop Drawings**: Include the Grounding detail.
 - B. **Assembly, Erection and Installation Drawings**.
 - C. **Manufacturer's Data**.
 - D. **Samples**: submit three each of the following:
 - 1. 300 mm (12 in.) square samples of the finished metal for the flagpoles.
 - 2. Each accessory specified.
- 1.4 **QUALITY ASSURANCE**
- A. **Manufacturing Standards**: Provide each flagpole as a complete unit produced by a single manufacturer, including fittings, accessories, bases and anchorage devices.
 - B. **Design Criteria**
 - 1. Provide flagpoles and installations constructed to withstand the following design criteria, unless otherwise indicated. Use heavy pipe sizes if required for the flagpole type and height shown.
 - 2. The design wind velocity 132 km/hr, but the Contractor shall verify conditions to the extent practicable and design poles, fastenings and other parts of the work to withstand, without damage, the maximum winds likely to occur. In any event, horizontal design wind pressure shall be taken as not less than 1197 Pa 2 (25 lbf/ft).
 - 3. Dimensions shown for the flagpole bases are minimum. Where design criteria indicates that dimensions shown are inadequate, provide larger bases to suit the criteria.
 - C. **Pole Construction**: Construct pole and ship to the site in one piece, if possible. If more than one piece is necessary, provide snug-fittings, precision

joints with self-aligning, internal splicing sleeve arrangement for weather-tight and invisible field joints.

1.5 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's technical data and installation instructions for each type of flagpole required.
- B. Shop Drawings: Submit shop drawings of flagpoles and bases, showing general layout, jointing and complete anchoring and supporting systems.
- C. Samples: Submit samples of finished metal for flagpoles and accessories as may be requested. Review will be for color and texture of finish only.

- 1.6 PRODUCT HANDLING: Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles so as to prevent damage and soiling.

PART 2 PRODUCTS

2.1 FLAGPOLES

- A. Type: Cone tapered stainless steel flagpoles, heights as shown, complete with internal halyard systems.
- B. Taper: 25 mm to every 2.18 m (1 in to every 7.14 ft) of length, or standard taper ratio for manufacturer's extra heavy duty line of flagpoles.
- C. Materials and Equipment
 - 1. Pole: AISI type 316 stainless steel with special soft tone, smooth texture, uniform, mechanical flagpole finish designed to reduce dirt-oxidic buildup.
 - 2. Halyard Flag Snaps: Provide 2 neoprene or vinyl covered swivel snaps per halyard.
 - 3. Internal Halyard System: Furnish poles with an internal halyard system consisting of a manually-operated, geared winch with control stop device and removable handle. Provide stainless steel braided aircraft-type cable and a concealed revolving truck assembly with extra heavy rubber or plastic coated counterbalance and nylon roller sling.

PART 3 - EXECUTION

- 3.1 INSPECTION: Examine surfaces and structures on which the flagpoles are to be erected and grounded. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from excavation, and wet the earth before placing concrete.
- C. Flagpole Installation: Install flagpoles as shown and in compliance with the final shop drawings and the manufacturer's instructions.
1. Provide positive lightning ground for each flagpole installation.

DIVISION 14

CONVEYING SYSTEM

DIVISION 14

CONVEYING SYSTEM

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ELECTRIC TRACTION LIFTS**PART 1-GENERAL****1.01 SCOPE**

This specification covers the complete supply and installation of lifts plant intended to be used for the Project in accordance with the Drawings, specifications and to the satisfaction of the Engineer.

All electrical and other works related to the complete installation of lifts shall comply fully with the relevant provisional By-laws issued by the Local Authorities and in accordance with the applicable requirements of the Division 16 Electrical Works.

All accessories or other items necessary to the completeness of the lifts work, though not specifically shown on the Drawings or specified herein, shall also be provided under this Section.

Work under this Section shall include but shall not be limited to the following and as per the lifts schedules:

- Installation of Two passenger lifts (L1& L2).

Only firms having local supplier/representative established for 10 years at least shall be approved.

All lifts shall have battery operated emergency landing system.

All lifts control panels shall be equipped with necessary auxiliary relays and contactors for interfacing with fire alarm and building management systems.

The bidder shall imperatively include in his quotation without any future risk and for claim or variation:

- All expenses rated to Third party testing as per EN 81 requirements. Third party to be selected by Client/Engineer only.

1.02 GENERAL REQUIREMENTS

The Contractor shall supply all labor and material necessary and shall install, complete and ready for use, the lifts plant.

The Contractor shall carry out the whole of the lifts work in a workmanlike and substantial manner and in strict conformances with the codes listed in the following clauses or approved equal.

All equipment and material supplied for the lifts plant of this project shall be manufactured in strict compliance with the standards listed in the following clauses, or approved equal.

A. Qualifications:

1. The work of this section shall be performed by one regularly engaged in the business of manufacturing, installing and servicing conveying systems of the type and character required by these specifications, he shall manufacture all major parts of the equipment and he shall so state in his request for acceptance listing the items he manufactures.
2. Prior written acceptance is required for manufacturers other than the ones listed, before quoting this project. Requests for acceptance will not be considered unless they are submitted before bid date and are accompanied by the following information:
 - a) List of two similar installations having exact equipment being proposed for this project arranged to show name of project, system description and date of completed installation.
 - b) Complete literature, performance and technical data describing the proposed equipment.
 - c) List of ten service accounts by building name, building manager or owner, including phone numbers.
 - d) Location of closest service office from which conveying system will be maintained.
 - e) Location of closest parts inventory for this installation.

B. Regulatory Agencies

1. All clearances, workmanship, construction, design and materials shall be in accordance with the requirements of the latest governing Code and all codes or rules other authorities having legal jurisdiction, and the codes hereinafter named.
2. The governing code shall take preference except where other codes having jurisdiction include more stringent rules or conflict with governing code.

C. Reference Standards

1. Only and exclusively latest EN (European Norms) for lifts (EN-81) – all other foreign norms is strictly rejected. Any supplier who will not abide by this requirement is automatically disqualified.
2. Local Code for lifts.
3. Local Electrical and Fire Protection Codes.

D. Permits, Inspections and Tests

1. File necessary drawings for approval of all authorities having jurisdiction, obtain and pay all required fees for permits and inspections, etc., which may be required for the execution of his work. Copies of all permits shall be forwarded to the Consultant.
2. Obtain, arrange and/or pay for any necessary permits, tests and inspections.
3. Furnish all test instruments and materials required at the time of final inspection. The inspection outlines in the latest governing code will be followed.
4. After hour tests of systems such as emergency generators or fire service shall be conducted at no extra cost to the owner.

1.03 SUBMITTALS**A. Submit the following:**

1. Samples

<u>Item No.</u>	<u>Size</u>	<u>Description</u>
* For each lift	300 x 300mm	Exposed finishes as requested by Architect
2. Shop drawings		
a) Machine room plan indicating:		
* Location of Equipment		
* Service Connections		
* Reactions		
b) Fully dimensioned hoistway/wellway plan and section of each unit indicating:		
* Platform (with cab), hoistway, and entrance dimensions		
* All running clearances		
* Location of fixtures		
* Buffers, service ladders and pit reactions		
* Rail reactions		
* Location of inserts		
c) Entrance details.		
d) Fixture details.		
e) Cab details.		
f) Wiring diagrams.		
g) Insert risers		

3. Calculations

- a) Rail loads calculations under safety gear as per EN81.
- b) Pit and machine room reactions
- c) Heat emissions in machine room.
- d) Electrical loads including starting, accelerating and running currents. Include all auxiliary loads.

B. Diagrams and Manuals issued prior to Final Payment

1. Furnish three (3) sets of neatly bound instructions giving the method of control and operation, together with data on all switches, relays and other devices as will be needed for serving and for ordering replacements.
2. Furnish three (3) sets of bound instructions and recommendations for maintenance, with special reference to lubrication and lubricants.
3. Furnish three (3) sets of complete and legible “as built” field wiring diagrams, layouts and straight line diagrams showing the electrical connections, functions, and sequence of operation of all apparatus connected with the system both in machine room and in hoistway, together with photographs or cuts of controller repair parts with part number listed.
4. Control circuit diagrams/spare part Catalogs/Manufacturer Service Manuals/Manufacturer/Suppliers guarantees (e.g. ropes = 5 years, motors, = 5 years).

1.04 **ELECTRICAL REQUIREMENT**

A. **Electrical Service**

The system shall be designed to accept the incoming AC power supply, which is 380 volts, three phases, 50 Hz, alternating current. The supply for illumination, fan and control shall be on 220 volts, single phase alternating current.

B. **Wiring**

The lift shaft shall be exclusively used for the lift. It shall not contain cables or devices etc...

Only cables forming part of the lift installation shall be run in the lift shaft in accordance with EN81 safety codes. Cables fixed in the lift shaft shall be enclosed in metal conduit, metal duct or metal trunking.

The Contractor shall supply, install and connect all wiring from the lift panelboard adjacent to the lift room door upto the Controller and lift car and from controller to all stations, panels and signaling devices.

C. Disconnecting and Protection Means

The disconnecting, short circuit and ground fault protection means of the controller, which will be provided under a separate section in the form of a power panelboard, will be as follows:

- a) Individual triple pole circuit breakers for every lift motor.
- b) Individual single pole circuit breakers for the control circuit of every lift motor.
- c) One single pole circuit breaker for common group system control and common signaling lights as applicable.

In addition lighting and fan of each lift car will be provided with a separate circuit breaker(s).

The electric lighting supplies to the car, the well and the machine room and the supply to socket outlets required on the car roof, in the machine room and in the pit shall be independent of the supply to the lift motor, either through another circuits or through connection to the lift motor supply circuit on the supply side of the main switch.

The controller shall be electrically assembled and connected such that it shall accept separate circuits from every breaker described above.

A warning sign both in Arabic and English shall be provided on the door of each controller with the following inscriptions:

"WARNING-EVERY COMPARTMENT HAS THE FOLLOWING SWITCHES IN THE PANELBOARD ADJACENT TO THE LIFT ROOM DOOR TO BE OPENED TO DEENERGIZE THE COMPARTMENT COMPLETELY: MOTOR BREAKER, CONTROL BREAKER, AND COMMON GROUP SYSTEM CONTROL BREAKER".

A similar warning shall be provided on a board and shall be hung above the panelboard adjacent to the door.

The contractor shall coordinate with the Electrical Works section for the appropriate breakers ratings and quality and shall approve them if they are to his satisfaction.

1.05 COORDINATION WITH OTHER TRADES

The Contractor shall at an early stage coordinate with work to be done under other sections such as shaft dimensions, pit depth, machine room dimensions, levels and structural requirements, doors clearance, power panelboard including number of circuits allocated, circuit breaker ratings, feeders sizes, conduits and empty boxes for control wiring and signaling equipment, etc.

The Contractor shall be responsible for any future problems that might arise due to the miscoordination with other trades and shall foresee at an early stage all necessary requirements to be able to install the system as specified herein.

1.06 HANDLING AND STORAGE

Lifts equipment shall be protected against mechanical damage and from the weather especially from water dripping or splashing upon it, at all times during shipment, storage, and construction. Equipment shall not be stored outdoors. Where equipment is installed or stored in moist areas such as unheated buildings, etc., it shall be provided with an acceptable means to prevent moisture damage. This may be a uniformly distributed source of heat to prevent condensation.

Should any equipment or material be subjected to possible damage by water, it shall be dried out thoroughly and put through a special dielectric test as directed, at the expense of the Contractor or shall be replaced by the Contractor without additional charge.

1.07 ACCEPTANCE TESTS

Any work, which is not in accordance with the specifications, shall be removed and repaired at the Contractor's expense.

All material must be factory finished and/or painted to the approval of the Engineer.

1.08 MODIFICATIONS

If during the work, the Contractor wishes to make changes or modifications, these modifications shall be submitted to the Engineer for approval. If these changes result in extra expenses in design and/or material, these expenses shall be borne by the Contractor.

1.09 WARRANTY

Warrant the equipment installed under these specifications against defects in material and workmanship and corrects any defects not due to ordinary wear and tear or improper use or care which may develop within one year from the date each elevator is completed and placed in permanent operation and accepted by the Owner and Construction Manager. This section shall apply separately to each unit as completed and placed in operation.

This warrantee shall be written and issued at the completion of each unit prior to final payment. Warrantee period starts after handing ones the project.

1.10 MAINTENANCE

Furnish full protective maintenance on the equipment described herein for a period of one (1) year from the date of final acceptance of the entire installation. The maintenance shall include systematic monthly examinations, adjustments and lubrication of all equipment. Also repair or replace any parts of equipment whenever this is required during the maintenance period and shall use only genuine standard parts produced by the manufacturer of the equipment installed.

All work under the maintenance provisions shall be performed by competent personnel under the supervision and in the direct employ of the Contractor, but 24-hour emergency call back service shall be available at all times and be included in the cost of the contract.

Provide interim maintenance on all units completed and put in service prior to the overall project completion.

1.11 **TEMPORARY USE**

Should there be a requirement for the use of an elevator during construction, the contractor shall provide at his expense, temporary car enclosure, required guards and protective barriers, power lights, and any special labor related to such temporary service. The Contractor shall also assume all charges connected with testing and maintenance required for temporary service.

All equipment shall be restored to a "like new" condition at the Contractor's expense prior to acceptance of the work by the Construction Manager.

PART 2-PRODUCTS

2.1 **MANUFACTURERS**

Subject to compliance with requirements, provide products by one of the following Suppliers:

- Mitsubishi (Japan & Thailand)
- Otis (France)
- Fujitec (Japan)
- Kone (Exclusively from Finland)
- Schindler (Switzerland)
- Hitachi (Japan)

Or any approved equal

2.2 **TRACTION EQUIPMENT**

2.2.1 **GENERAL**

The machine shall be of the single wrap traction, type, and shall include a motor, electro-mechanical brake, steel worm, bronze gear, steel sheave shaft and ferromolybdenum sheave all compactly mounted on a single base or bedplate. The worm shaft shall be provided with ball bearings to take the end thrust, and roller bearings shall be furnished for the sheave shaft to insure alignment and long bearing life. The driving sheave shall be grooved to insure sufficient traction and minimize rope wear. Adequate means of lubrication shall be provided for all bearings and the worm gear.

2.2.2 **BRAKE**

The direct current brake shall be spring applied, electrically released, and designed to provide smooth stops under variable loads. The braking system shall be operated automatically:

- a) In the event of loss of the main power supply.
- b) In the event of loss of the supply to control circuits.

Means shall be provided for manual release of the brake in order to allow manual winding of unit in emergencies. The brake emergency release shall be self-resetting.

2.2.3 **SHEAVES**

The traction sheave shall be made of fine grained cast iron of the proper hardness accurately grooved for the proper number and size of hoisting ropes and shall be designed to give constant traction and long rope life. All deflector sheaves necessary to obtain the proper lead of the ropes shall be provided and shall have similar construction as the traction sheave. Sheaves shall rotate in grease lubricated bearings and shall be carried by steel shafts supported by steel beams or channels.

The main sheave and deflector pulley shall be provided with rope protectors (EN81-6.1.2.1.4).

A guard extending below the machine level shall be provided underneath of deflector and secondary sheaves.

2.2.4 **MOTOR(S)**

Each electric motor for lifts specified with VVVF drive shall be squirrel cage induction motor designed for Variable Voltage Variable Frequency drive. The VVVF system shall be scalar-controlled using pulse width modulation and closed loop feedback. The voltage and frequency parameters of the power supplied to the drive shall be adjusted in real-time to insure that the optimum torque is obtained from the drive motor at all points in the designed speed profiles. Control of variable voltage variable frequency AC supply shall be obtained by first rectifying normal mains AC power to DC. Power transistor circuits shall be used to invert the DC to a controllable AC power supply. The subsequent frequency applied to a drive system shall be determined by data from the controller logic board and motor current feedback. Distance speed control shall ensure consistent speed profiles with optimum ride quality irrespective to load.

2.2.5 **MACHINE - MOTOR ASSEMBLY (MACHINE ROOM ABOVE LIFT)**

The motor, brake, gear box (if any), and bearings shall be mounted as one unit assembly on a common bed plate to ensure proper alignment and support.

Each lift machine shall be adequately isolated from the main building structure by means of 50 mm thick cork slabs to prevent transmission of noise and vibration. They shall also be statically and dynamically balanced for quiet operation.

A steel joist, of adequate strength shall be furnished and fixed in each machine room to facilitate lifting of the machinery.

2.3-AUXILIARIES

2.3.1 GUIDE RAILS

The Contractor shall supply and install all supporting steel beams and all other steelwork required for the lifts.

Planed steel tees shall be provided as guides for cars and counterweights. The guide surfaces shall be accurately machined and polished. Steel splice plates of adequate strength shall be used to connect the rails together in proper alignment.

The guide rails shall be fixed to the walls of the hoistway by means of heavy steel brackets to metal inserts built into the walls. The brackets shall be so spaced that rail vibration during lift operation is minimized.

The guide rails and their fixing shall be capable of withstanding the sudden application of the safety gear under maximum load conditions.

2.3.2 TERMINAL BUFFERS

Spring buffers shall be installed as a mean of stopping the car and counterweight at the extreme limits of travel for elevators of speed up to 1m/s above 1m/s oil buffers should be installed. Buffers in the pit shall be mounted on steel channels, which extend between the car and counterweight guide rails.

2.3.3 COUNTERWEIGHT

1) Counterweight shall consist of a steel frame welded or bolted together and necessary steel sub-weights. These sub-weights shall be held within the frame by not less than 2 tie rods passing through holes in all weights. The rods shall be equipped with locknuts, secured by washers and cotter pins at each end to keep the sub-weights in place and prevent rating.

One. The counterweight shall be equal to the weight of the elevator car and approximately 40% of the contract (specified) capacity.

Two. Provide the required counterweight screen where no compensation is used.

Three. The bottom of the counterweight shall have a buffer striking plate and means to attach knock-off blocks during rope stretch.

2) The counter weight shall be provided with safety whenever there exist an accessible space under the pit.

3) Compensation:

a. Provide compensation for the weight of the hoistway ropes and unbalanced portion of the traveling cables.

- b. The elevators shall be equipped with jacketed chain compensation. Provide funnel type guidance system in the pit to prevent excess sway of the compensation chain.
- 4) Work Lights and Receptacles
- a. Install a single lighting receptacle on each car in an inconspicuous location.
 - b. Provide work lights and receptacles at top and bottom of elevator car. Provide lights with wire guards and local switch.

2.3.4 **ROPES**

The suspension (hoist) ropes shall be of special acid quality steel of high grade traction steel of suitable size, construction and number especially designed for lift duty, having a factor of safety of at least 12. Approved means of attaching the ropes to the car and counter-weight shall be provided.

Ends of hoisting ropes shall be secured with adjustable rope shackles with springs, washers, nuts and end cotter pins.

Metallic edges around ropes on slab shall be installed.

Independent adjustment shall be provided for each rope. Governor ropes shall be of steel.

2.3.5 **CAR SAFETY AND GOVERNOR**

A centrifugal governor, independent of the other elevator machinery shall be provided. On overspeed the governor shall cut off the power to the motor and set the brake should the speed still increase, the governor shall actuate two safety rail clamps mounted at the bottom of the car. These devices shall clamp the guide rails by wedging action, bringing the car to a smooth stop.

The overspeed governor shall be driven by a very flexible wire rope. The breaking load of the rope shall be related by a safety factor of at least 8 to the tensile force produced in the rope of the overspeed governor when tripped.

The nominal rope diameter shall be at least 6 mm.

The ratio between the pitch diameter of the pulleys for the overspeed governor rope and the nominal rope diameter shall be at least 30.

The rope shall be tensioned by a tensioning pulley. This pulley (or its tensioning weight) shall be guided.

The overspeed governor shall be accessible for inspection and maintenance.

It shall return after tripping automatically into the normal position, as the car/counterweight is moved in the upward direction.

Safety Gear is to hold car securely under maximum load and governor tripping speed conditions. Jaws of gear are to engage guide rails through self-aligning shoes with surfaces carefully machined parallel to guide rail face. Pressure of jaws on the two guides is to be equal. Safety gear is to bring car to stop from governor tripping speed. Method of stopping is to be smooth, instantaneous or gradual as specified in Schedule Deceleration is to be inferior to gravity.

Governor is to be accurately adjusted and sealed to trip safety gear at 115% (maximum), of car's specified speed. Operation of governor on over speed is also to open a switch disconnecting power from motor and brake control circuits, which are to be open before safety gear is applied. Restoration of power is not to be possible until safety gear has been manually reset.

2.3.6 **TERMINAL AND FINAL LIMIT SWITCHES**

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings, and final limit switches shall be furnished to automatically cut off the power and apply the brake if the car travels beyond the terminal landings.

Electrical final-limit switches shall be located at proper distances below and above the safe travel limits of the car. These switches shall de-energize the traction motor and shall set the main brake.

2.3.7 **AUTOMATIC TERMINAL STOPS**

Each lift shall be equipped with an automatic stopping device, arranged to bring the car to a stop accurately at the terminal landing independent of the regular operating device in the car. Final limit switches shall be provided in the hoistway, operated by the car and arranged to stop the car and prevent normal operation, should it travel beyond the zone of the normal stopping device.

Automatic Leveling Device shall provide compensation for thermal expansion, elevator loading and normal rope stretch.

2.3.8 **PIT SCREEN**

A substantial screen shall be fixed at the bottom of the elevator well where the counterweight comes down to the buffers.

2.3.9 **ALARM BELL**

An emergency alarm bell, including wiring shall be provided and connected to plainly marked push button in the car operating panel. The alarm bell shall be located in the main lobby or place approved by the Engineer at site. Batteries and trickle charger shall be provided for the alarm circuit.

2.3.10 TOP OF CAR STATION

Mount an inspection station on top of car. This device shall be activated by a switch located in car operating panel and shall include:

- a) Up and down direction buttons
- b) A stop switch
- c) A simplex outlet
- d) A work light with wire guard and an “off”-“on” switch.
- e) Emergency stop switch

When the station is operational, the elevator speed shall not exceed 0.75 mps and all operating devices in the cab shall be inoperative.

2.3.11 LIGHTING FIXTURES IN HOISTWAY

Lighting fixtures with IP 55 degree of protection and protective wire guard and shockproof cover shall be provided 50 cm above bottom of hoistway and 50 cm below upper level of hoistway with lighting fixtures regularly spaced between the two fixtures at both ends of hoistway, with an interval not exceeding 3.5 m.

Switching device of the hoist way light to be located in machine room.

Lighting fixtures in hoistway and pit shall be an integral part of the lift contract.

2.3.12 ELECTRICAL DEVICES IN PIT

A stop switch shall be provided with all necessary control wires and conduit in the pit as an integral part of the lifts contract.

The stop switch shall stop the lift and keep it stopped.

A 16A 2P+E 220 V socket outlet with IP 55 degree protection shall be provided in the pit as an integral part of the lifts contract. An alarm device shall be provided in places where trapping is possible.

2.4-CONTROL SYSTEM

2.4.1 SIMPLEX FULL COLLECTIVE OPERATION

The operation shall be full collective automatic type with one button in the car for each landing level served. One set of Up and Down buttons shall be provided at the intermediate landings and a single button at each terminal landing. All stops registered by the momentary pressure of the car buttons shall be made in the order in which the landings are reached after the buttons have been pressed, but irrespective of the sequence in which calls were registered. Calls registered by the momentary pressure of buttons at the landings shall be made in the order in which the landings are reached in each direction of travel after the buttons have been pressed. All Up landing calls shall be answered when the car is travelling in the Up direction, and all Down landing calls shall be answered when the car is travelling in the down direction, except in the case of the uppermost or lowermost call which shall be answered as soon as it is reached.

2.4.2 CONTROL EQUIPMENT AND FEATURES

A. Wiring

- 1) Provide all wiring and conduit required for the operation of the elevators.
- 2) Wiring, conduit and all fittings shall be in accordance with requirements of Division 16.
- 3) Run all wiring in galvanized conduit or in metal wireways.
- 4) Flexible metal conduit with ground wiring may be used for short runs from main hoistway wireway to interlocks, fixtures, limit switches and between control panels, motors and brakes.
- 5) Provide traveling cables with polyvinyl chloride and flame resistant outer cover. Pre-hang the cables for at least 24 hours with ends suitably weighted to eliminate twisting during operation.
- 6) Provide at least 10% spare in travel cables and in all hoistway risers.
- 7) Provide six (6) pairs of 18 gauge shielded cables in traveling cable for each car. Terminate them to barrier-type terminal strip behind elevator return panel at one end of cable and within a machine room security junction box at the other end.
- 8) Where the main elevator disconnect devices are not located in the machine room or they are not in the view of the hoist machines, provide necessary auxiliary disconnect means to meet the requirements of the code.

B. Motor Controller**1) Enclosure**

The lift controller shall be of vertical, totally enclosed, cubicle type constructed of sheet steel with hinged doors on the front and screwed panels on the back, giving easy access to all components inside the controller. The cubicle enclosure shall be such as not to post any danger of shock or injury to personnel. The cubicle closure shall be well ventilated by means of louvers or other approved method, such that the temperature inside never exceeds the safe temperature of the equipment.

The controller shall house contactors, solid state devices relays, selectors, timing devices, transformers and all apparatus associated with the control of the lift in the machine room.

- 2) Provide a microprocessor controlled variable voltage, variable frequency drive consisting of a converter/inverter system which first rectifies the AC supply to DC power, then using PWM technique converts DC into variable voltage and variable frequency AC power to drive the hoisting motor. The speed of the motor shall be controlled by varying the power supply frequency and voltage level. Provide a closed loop feedback control and a car position transducer for smooth operation and accurate leveling.
- 3) The controls shall provide smooth stepless acceleration/deceleration regardless of load, accurate speed regulation and efficient operation.
- 4) Place motor control unit in a ventilated cabinet with hinged doors. Separate and isolate regulator and control section from the control unit.
- 5) Built-in protection devices shall include:
 - a) Reverse phase relay
 - b) Phase loss relay
 - c) Tachometer overspeed and tachometer loss protection
 - d) Thermal protection
 - e) Short circuit and ground fault.

C Controller/Dispatchers

- 1) The elevators shall have microprocessor based controller/dispatchers.
- 2) Provide totally enclosed units with a self-supporting steel frame.
- 3) Ventilate units and provide hinged doors for service.
- 4) Mount equipment to moisture-resistant, noncombustible panels. Support these panels from steel frame.
- 5) Provide “noise filter” between hoistway wiring and controller/dispatchers to eliminate interference.

-
- 6) Optically isolate communication cables between units.
 - 7) Wiring: Wiring on the units, whether factory or field wiring, shall be done in neat workmanlike order, and all connections shall be made to studs and/or terminals by means of grommets, solderless lugs or similar connections. All wiring shall be copper.
 - 8) Terminal Blocks: Provide terminal blocks with identifying studs on units for connection of board wiring and external wiring.
 - 9) Marking: Identifying symbols or letters shall be permanently marked on or adjacent to each device on the unit, and the marking shall be identical with marking used on the wiring diagrams. In addition to the identifying marks, the ampere rating shall be marked adjacent to all fuse holders.
 - 10) Diagnostics: The dispatcher shall have its own CRT Scope built in the cabinet for diagnostic work. When a fault is detected, the diagnostic system will record the fault code in a nonvolatile memory along with the location of the elevator and the time of day. CRT shall be used to retrieve this information on every call. The fault information shall include, but not limited to:
 - a) Elevator position, travel direction and mode of operation.
 - b) All safety circuits.
 - c) Processor power supply and processor and Input/Output status.
 - d) Door safety circuits.
 - e) Door zone signals.
 - 11) Selector: A new floor selector shall be part of the controller microprocessor. Position determination in the hoistway may be through fixed tape in the hoistway or by sensors fitted on each driving machine to encode and store car movement.

Design the mechanical features and electrical circuits to permit accurate control and rapid acceleration and retardation without discomfort.

D. **Overload Alarm**

Each car shall have an overload protection control to interrupt operation, sound and alarm bell within the car and to lit an overload indicating pilot light, when the load in the car exceeds the nominal load, the overload device shall be activated to protect the machine from consuming more than the original rated power.

E. **Automatic By-Pass**

A full load by-pass feature shall be provided which prevents a fully loaded cab from stopping to answer landing calls, such calls to remain in the system to be answered by the other elevator (if any).

F. Anti Nuisance Device

If the load in the car is less than 100 kg and the number of registered car calls exceeds three (3), all car calls will be immediately cancelled.

G. Automatic Car Return Device

After a pre-determined interval, and if no call has been registered, the elevator is to be automatically sent to a selected floor. After such an operation, when the car arrives to the selected floor, the doors shall not open unless a hall call is made.

H. Detector Edge:

- a. Provide an Infra-red curtain door protection system on all cars.
- b. The doors shall be prevented from closing from an open position if a person interrupts any one of the light rays. When the doors are closing, any Interruption of the protective light field shall cause both the car and corridor doors to reverse. The doors shall start to close when the protection system is free of any obstruction.
- c. The infra-red curtain protective system shall have:
 - (1) Height of protective field not less than 1.8 m above the sill.
 - (2) Where horizontal infra-red light beam system is used:
 - A minimum of 30 light beams
 - Accurately positioned infrared lights to conform to the requirements of the applicable handicapped code.
 - (3) Modular design to permit on board test operation and replacement of all circuit board without removing the complete unit.
 - (4) Controls to shut down the elevator when the unit fails to operate properly.

I. Electrical Recall Operation

Control device in machine room in order to operate lift at low speed for maintenance.

J. Independent Service

This special operation is to be generally initiated by a keyswitch located in the car operating panel. When switched on independent service:

- The elevator is removed from the system and no longer answers hall calls, but only car calls.
- The closing of the door is obtained only by a constant pressure on the car button to other landings.

K. Voice Synthesizer

A voice recorder which produces the human voice to communicate, by means of a loudspeaker in the car, concerning information related to all possible functions in the elevator. All messages should be held in permanent electronic memories (EPROM), which retain the information even in the event of power failures.

L. Door Operation

Door Contact – Equip the car door with an electric contact, which will prevent operation of the car unless the car door is in the closed position. The door contacts shall not be readily accessible from the inside of the car.

Doors on the car and at each hoistway landing shall be power operated by means of a quality operator mounted on top of the car. The door operator shall be powered by variable speed variable voltage motor and shall have positive control over door movement for smooth operation.

A safety shoe shall be furnished at the edge of the car door to cause instant reopening should contact be made with an obstruction during the closing cycle.

If the doors are prevent from closing for a fixed pre-determined time, the doors shall close at a reduced speed independent of the detector device. While the doors are closing at a reduced speed, a loud buzzer in the car shall sound.

Door operation shall be automatic at each landing.

A car door electric contact shall prevent starting the elevator away from the landing unless the car door is in the closed position.

The time interval for which the elevator doors remain open when a car stops at a landing shall be independently adjustable for response to car calls and response to hall calls.

The maximum time to completely open and completely close the doors shall be specified and guaranteed.

M. Nudging

If the doors are held open for a predetermined time (15 to 20 seconds; individually adjustable) by interrupting the light rays/detector field, or by holding the door, or by pressing the door open button, a buzzer will sound and the doors shall start to close at a gentle slow speed.

N Automatic Terminal Stops

Each lift shall be equipped with an automatic stopping device, arranged to bring the car to a stop accurately at the terminal landing independent of the regular operating device in the car. Final limit switches shall be provided in the hoistway, operated by the car and

arranged to stop the car and prevent normal operation, should it travel beyond the zone of the normal stopping device.

Automatic leveling Device shall provide compensation for thermal expansion, elevator loading and normal rope stretch.

O. **Automatic Operation by Emergency Power**

The electric control system shall have automatic change over switches and sequential relays to operate the system using emergency power source in case of power failure. This automatic switch shall automatically operate one or more cars at a time, to bring them to the nearest landings, and shall operate one or more pre-assigned cars on emergency power. When normal power is restored, all cars shall automatically return to normal operation again.

P. **Automatic Re-leveling**

1. Equip the elevators with a floor leveling device, which shall automatically bring the car to a stop within 6 mm of floor with any floor for which a stop has been initiated, regardless of load or direction of travel. Provide an automatic releveling device, which shall be arranged to automatically return the elevator to the floor in the event the elevator should creep down a predetermined distance below floor level. This device shall be operative at all floors served, whether the hoistway door or car door is open or closed, or whether the emergency stop switch has been thrown, provided there is no interruption of power to the elevator.

2.4.3 **EQUIPMENT ISOLATION**

Provide sound reducing vibration isolation elements at all support points of elevator controllers, solid-state motor drives, isolation transformers and hoisting motors. The elements for controllers, solid-state motor drives and isolation transformers shall be similar to double deflection neoprene-in-shear mounts, with 0.35" static deflection under design load ratings. Elements between the hoisting machine (unitized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims at 50 durometer, loaded for 40 psi. All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.

2.4.4 **SPECIAL REQUIREMENTS**

Handicapped Requirements

1. Locate the alarm button and emergency stop switch at 900 mm, and floor and control button not more than 1375 mm.
2. Provide raised markings in the panel to the left of the floor and control buttons. Letters and numbers shall be a minimum of 15 mm and raised .75 mm and shall be in contrasting color to the call buttons.

3. The centerline of the hall pushbutton station shall be 1075 mm above the floor.
4. The hall lanterns or cab lantern shall sound once for the "up" direction and twice for the "down" direction.
5. Provide floor designations at each entrance on both sides of jamb at a height of 1500 mm above the floor. Designations shall be 50 mm high, raised .75 mm and shall be custom designed by Interior architect.

2.4.5 **SAFETY & SERVICE FUNCTIONS**

A. **Rescue Operation to the Nearest Landing:**

Should the elevator stop between stops, a 'rescue operation' takes place. The elevator confirms the safety circuit and then automatically moves slowly to the nearest landing and opens the doors.

Note: If a statutory safety or protective circuit is activated, this operation will not be initiated.

B. **Door Opening Failure Rescue Operation:**

When an elevator arrives at a landing and cannot open the doors due to foreign material, such as a pebble jammed into the doorsill groove, the elevator will proceed to the next landing and open the doors.

C. **Door Safety Return:**

If something is caught during the door opening and closing motion, the door operation will be reversed. When foreign material, such as a pebble or trash gets clogged into the doorsill groove, the doors will repeatedly open and close trying to remove the obstructing materials.

D. **Open Door Warning:**

A warning buzzer sounds if a passenger tries to forcibly open the elevator doors while the car is running.

E. **Automatic Door Dwell Time Control:**

A microcomputer automatically improves operation efficiency as it adjusts the 'door open dwell time' depending on the hall and car call's registration situation.

F. **Nuisance Call Cancellation:**

If an extraordinary number of car calls are registered compare to an in-car load, the computer judges it as a nuisance attempt; all registered car calls are automatically cancelled. This prevents unnecessary elevator operation and maintains efficiency of operation.

G. Behind Car Call Cancellation:

Car calls for a floor opposite to the direction the car is running, will not be registered to prevent nuisance attempts; maintaining efficient operation.

H. Car Call Cancellation:

The wrong floor selection can be cancelled by repressing the car call button twice in row. This will eliminate unnecessary elevator trips and stops provide efficient operation.

I. Parking Switch:

The switch puts the elevator out of service during nights and holidays. This function is advantageous for security and energy saving purposes.

J. Automatic Fan and Light Control:

During off-peak operation hours, the ventilating fan and lights automatically shut off resulting in energy savings.

K. Automatic Return to Main Floor:

The elevator will return to the pre-set main floor to standby if car calls are not registered. (Available for 2 or more Car Selective Collective Operation).

L. Load Bypass:

When an elevator is loaded close to capacity, it will bypass hall calls. The registered hall calls will be assigned to other elevators. (Available for 2 or more Car Selective Collective Operation).

M. Door Nudging:

When the doors are held open beyond the pre-set period of time, the doors slowly start closing while sounding a warning buzzer. This helps prevent a decline in the elevator's operation efficiency.

N. Independent Operation:

A specified car is separated from the group and is singly operated responding only to car calls. The operation is started with an external switch.

O. Multiple Beams Door Sensor:

Infrared beams will run the full opening height like a beam curtain. If any of the beams are interrupted, the closing doors will stop and reopen. Since the multiple beams sensor covers the whole area, it is much easier to detect a person or an obstruction.

P. Emergency Fireman Service:

A two position key-operated fireman's service switch shall be provided in or adjacent to the operating panel in each car. The elevator shall respond only to commands from the car. Once in motion, the car shall proceed to the designated floor and stop with the doors closed.

The doors shall open in response to constant pressure on the Door Open Button. Doors shall immediately re-close when pressure is released before the doors fully open. When a power fluctuation occurs, the following actions shall be taken when power is restored:

- The car position maintained in non-volatile memory shall be used no initialization shall occur.
- Operation shall be immediately re-activated.

Note: Emergency Fireman Service to be installed for fire elevators..

Q. Battery Powered Automatic Landing Operation:

The emergency in-car light turns on automatically and a compact battery powered control system operates the car to the nearest landing.

R. Standby Power Operation:

If a power failure occurs, the elevators will return to an escape floor using standby power and will be held there on standby.

* The standby power equipment shall be supplied and installed by others.

S. Voice Synthesizer Announcement System:

By synthesized voice, automatic announcement system informs the passengers of the car direction, floor arrival, door opening and closing actions, emergency instructions, etc...

2.5-STATIONS, PANELS AND SIGNALING DEVICES**2.5.1 LANDING STATIONS (GENERAL)**

One landing station shall be provided for every two lifts of the same group or a fraction thereof in the following manner:

No. of lifts: 1 2 3 4 5 6 7 8

No. of stations per landing: 1 1 2 2 3 3 4 4

2.5.2 LANDING STATIONS (COLLECTIVE-SELECTIVE)

Within the faceplate each terminal landing station shall comprise one nonlocking pushbutton with red pilot light and each intermediate landing station shall comprise two nonlocking "Up and Down" pushbuttons and two direction arrows.

The relevant pushbutton shall lit on registering a call. When a car stops at a landing (in response to a car or landing call) one of the arrows shall lit showing which direction the car will travel next. A gong with the direction arrows specified above shall be provided above the landing doors in the form of hall lanterns if more than one car of the same mode of operation is served in a common lobby.

2.5.3 HALL POSITION INDICATOR (at all floors)

A stainless steel fixture holding a hall position indicator (digital display) is to be provided to show the position of the car in the hoistway by the illumination of the indicator corresponding to the landing at which the car is stopping or passing.

2.5.4 HALL LANTERNS (ALL FLOORS)

A stainless steel fixture containing a hall lantern is to be provided at all landings to show the impending arrival of the car to that landing indicating the direction in which the car is travelling prior to the arrival of the car.

2.5.5 CAR TELL TALE LIGHTS

It permits to identify calls registered in the car. The function is providing by illuminated car buttons.

2.5.6 EMERGENCY CAR LIGHTING

An emergency power unit employing 6V or 12V sealed battery and totally static circuits are provided to illuminate the elevator's car and provide current to the alarm bell in the event of power failure.

2.5.7 AUTOMATIC FAN

The function of the fan is to extract the air from the car/. It is operated by the controller automatically when the car is running and stops when the car is at rest.

2.5.8 DOOR OPEN BUTTON

When provided, the door open button permits to open the door and keep it opened as long as the button is pressed.

If not provided, door opening is brought by pushing the car call button corresponding to the floor at which the elevator is serving (or, of course, the car door safety contact).

2.5.9 DOOR CLOSE BUTTON

When provided, the door close button permits to close the door prior to the determined time given to the timer in the controller. If not provided, door closing is brought by waiting for the determined time.

2.5.10 CAR OPERATING PANEL

The car panels shall be flush mounted in the car enclosure.

Two car panels shall be provided for lifts with 12 passengers or more. The car panel shall contain the following:

- a) A bank of buttons to correspond to various landing levels served.
- b) Switches for light inspection and exhaust fan.
- c) An alarm button connected to the alarm bell as described herein before.
- d) One door open button.
- e) One door close button.
- f) Independent Service key operated switch.
- g) A slave intercom station (when indicated)
- h) Inscription both in Arabic and English indicating maximum number of persons and weight in kilograms allowed, minimum permitted age for lift use, instructions as to what to do during power failure or lift undue stoppage.
- i) Car position indicator.
- j) Graphic display (high definition LCD) that displays customized messages and images.

In the car the rated load of the lift in kilograms as well as the number of persons shall be displayed.

The minimum height of the characters used for the notice shall be:

- a) 10mm for capital letters and numbers.
- b) 7mm for small letters.

2.5.11 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Passenger elevators shall be adjusted to meet the following performance requirements:
1. Speed: within 5% of rated speed under any loading condition.
 2. Leveling: within 6 mm under any loading condition.
- B. Maintain the following ride quality requirements for the passenger elevators:
1. The speed of the car roller guides shall not exceed 500 rpm (when needed).
 2. Where pit permits, extend bottom roller guides by not less than one half the distances from the centerline of the upper roller guides to the platform (when needed).
 3. Noise levels inside the car shall not exceed the following:
 - a. Car at rest with doors closed and fan off -40 dba.
 - b. Car at rest with doors closed, fan running -55 dba.
 - c. Car running at high speed, fan off -50 dba.
 - d. Door in operation -60 dba.
 4. Horizontal accelerations, measured in either direction, shall not exceed 15 milli g in the frequency range of 1 to 10 Hz.
 5. Amplitude of acceleration and deceleration shall not exceed 1.2 m per second, per second. A sustained jerk shall not be more than twice the acceleration.

2.5.12 EMERGENCY FIRE OPERATION

All cars not on fireman's service shall be commanded to make an express priority run to the designated return landing as soon as a fireman's car is switched to emergency fireman's service. For EFO the cars are parked until the end of emergency fireman service.

Activation of any smoke detector in the lift lobby if any other than the main or lift machine rooms, shall initiate a signal to the lift control panel to cause all cars in all groups that serve that lobby to return non-stop to the main landing.

In case smoke detector at the main landing is activated, the cars shall return to approved alternative landing (unless the fireman's switch is in the "ON" position).

An elevator traveling away from the designated floor shall reverse at the next served floor without opening its doors and proceed to the designated floor without stopping. When the elevator is at the designated return landing with the doors fully open, the car can be placed on Fireman's Service.

2.5.13 EMERGENCY FIREMAN SERVICE

A two position key-operated fireman's service switch shall be provided in or adjacent to the operating panel in each car. The elevator shall respond only to commands from the car. Once in motion, the car shall proceed to the designated floor and stop with the doors closed.

The doors shall open in response to constant pressure on the Door Open Button. Doors shall immediately re-close when pressure is released before the doors fully open. When a power fluctuation occurs, the following actions shall be taken when power is restored:

- The car position maintained in non-volatile memory shall be used and no initialization shall occur.
- Operation shall be immediately re-activated.

2.5.14 COMMUNICATION SYSTEM**Intercom**

1. Provide an inter communication system for the elevator system which shall provide two-way multi-path communication between its elevator car stations and master stations.
2. Include the following stations in the system:
 - a. A car station in each elevator.
 - b. A master station in the machine room.
 - c. A master station in main control room.
3. The car station shall have a loudspeaker and a microphone to provide hands-free communication. The station shall be installed behind the car operating panel.
4. Provide the master station with selector push buttons, annunciator lights for each connected station, speaker/microphone, and volume control and function buttons. Install the master station in the remote monitoring panel. All other master stations shall be desk mounted. The machine room master stations shall be equipped for communications with the other master stations and any elevator in that group. The remote monitoring master station shall communicate with their respective stations in the system.
5. A call shall be placed from the elevator car station by pressing the emergency call button. This action shall cause the lamp in the corresponding button of all the designated master stations to flash and an intermittent tone to be heard. When the Incoming call is answered, the flashing light shall go to a steady condition. Disconnection of a call is simply done by depressing the designated car button once, thereby unlocking it and extinguishing the lamp. If a call request is placed during a conversation, it shall be indicated by a flashing light and short tone of every designated master station. When the original conversation is completed, the normal intermittent tone shall resume

6. A master station shall be connected to any of its designated car stations by depressing the corresponding call button. The lamp in the button shall be illuminated while the button is depressed. In the car station an audible one shall be emitted and immediate communication is established. The call shall be ended by depressing the button a second time, disconnecting the circuit. The master stations shall call any other master station by depressing the corresponding call button. The button shall lock in its down position and the lamp shall be lit with a steady light. At the called master station, a short tone shall be sent out and the lamp in the button corresponding to the “calling” party shall be lit. After the tone, immediate communication is established
7. On all non-called master stations, the lamps corresponding to the calling and called stations shall be illuminated as an indication that those stations are busy. By this it shall be also indicated that the speech channel is busy.
8. Provide all wire, conduit, fittings, etc., for both systems. Location of the stations, in the specified rooms, shall be directed by the Architect. The intercom system shall include the following features:
 - a) Test button to verify audio circuit path.
 - b) All call buttons to initiate a call to all cars in the systems.
 - c) Priority button in the remote monitoring panel stations.

2.5.15 **SMOKE DETECTOR**

A smoke detector shall be provided inside each car and inside well, in coordination with fire alarm system supplier.

2.5.16 **FULL PROTECTIVE MAINTENANCE SERVICE**

- A. Submit separate prices for a full maintenance service for all the elevators included in the Specifications, based on a five (5) year contract in accordance with the following:
 1. The service agreement shall commence at the termination of the maintenance period included in the base Specifications and shall continue for a period of five (5) years thereafter. Either party may terminate this agreement either at the end of the first five years or at the end of any subsequent year by giving the other party ninety (90) days written notice.
 2. The maintenance work shall be performed by elevator men directly employed and supervised by the manufacturer and installer of the equipment who are experienced and skilled in maintaining elevators similar to those to be maintained under this agreement.
 3. Except for emergency minor adjustment callback service, all work shall be performed during the regular working hours of regular working days of the trade. If, at any time, it should become necessary, and only when so authorized by the owner to perform any portion of the work other than emergency call-back service during overtime hours, the maintenance contractor shall be reimbursed at the established billing rates for the difference between regular and overtime labor.

4. Maintenance contractor shall maintain all parts of the elevators consisting of, but not limited to, machines, motors, pumps, valves, brushes, controllers, selectors, worms, gears, thrusts, bearings, brake magnet coils, brake shoes, windings, rotating elements, contacts, coils and resistance for operating and motor control circuits, magnet frames, leveling devices, cams, car and hoistway door hangers, tracks and guides, door operating devices, hall lanterns and all other elevator operating, signal and accessory equipment complete.
- B. The maintenance work shall consist of the following:
1. Supplying, repairing and replacing of all parts of every description made necessary by wear and tear at the maintenance contractor's cost: Only parts that are correctly designed and suitable in all respects shall be used. The maintenance contractor shall have and maintain on hand locally a supply of spare parts sufficient for the normal maintenance and repair of the equipment. The following items of elevator equipment are excluded: car enclosures, hoistway enclosures, hoistway doors, doorframes and sills, fluorescent light bulbs.
 2. Repairing and/or replacing all electrical wiring and conductors, extending to the elevator from the mainline switch or circuit breaker. Mainline switch fuses are excluded.
 3. Keeping the guide rails clean and properly lubricated, except when roller type guides are involved no rail lubrication shall be used. When necessary, the maintenance contractor shall renew guide shoe gibs or rollers as required to ensure smooth and quiet operation. All oil reservoirs shall be kept properly sealed to prevent leakage.
 4. Keeping the exterior of the machinery and any other parts of the equipment subject to rust properly painted and presentable at all times. The motor windings and controller coils are to be periodically treated with proper insulating compound.
- C. The maintenance contractor shall not be required to make renewals or repairs necessitated by reason of negligence or misuse of the equipment by persons other than the maintenance contractor, his representatives and employees, or by reason of any other cause beyond the control of the maintenance contractor, except ordinary wear and tear. The maintenance contractor shall not be required under this agreement to install new attachment as may be recommended or directed by insurance companies or Governmental Authorities.
- D. This service shall be performed solely by the manufacturer and installer of the equipment and shall not be assigned or transferred to any agent of subcontractor.
- E. The price shall be subject to adjustment each year as follows:
- The labor portion of the price shall be increased or decreased by the percentage of increase or decrease in the straight time hourly cost for the month within which falls the anniversary of the commencement of the service as compared with such straight time hourly labor cost on the date of the Contract.

2.6-ARCHITECTURAL FEATURES

2.6.1 ENTRANCE ARCHITRAVES

Entrance architraves to all lifts shall be made of stainless steel at all floors, and for passenger lifts to be as per Interior Architect requirements.

2.6.2 CAR

The car frame shall be manufactured from robust structural steel members, properly braced and securely fastened together.

The car platform shall be constructed of structural steel frame filled with a plywood flooring. The platform shall be equipped with an aluminum threshold plate and shall be mounted on rubber pads forming an isolating cushion between the car and steel car frame. Vinyl tile floor covering shall be furnished.

The assembly comprising the sling, guide shoes, walls, floor and roof of the car shall have sufficient mechanical strength to resist the forces, which will be applied in normal lift operation, in safety gear operation or impact of the car on its buffers. For car walls, made partially or totally from glass, laminated glass shall be used. Furthermore, they shall withstand the pendulum shock according to EN standard with a leather bag, filled with small shots, having a mass of 45 Kg. and falling from a height of 700mm without damage.

The car shall be provided with a high capacity ventilating fan of the silent-running type and of approved manufacturer. The fan and lights shall be automatically switched on when the car is called. Furthermore, fan and lights shall continue to be switched on while the car is not in operation. A time delay relay shall switch off the fan and light 30-60 seconds after the car has stopped. Provision shall also be made for natural ventilation of each car. Sockets shall be provided for inspection lamps inside the car, on the roof and below the car.

All Lifts rated for a weight of 800 Kg and above shall be provided with an access trap door of 350 mm x 500 mm (minimum size) on the top of the lift car.

All buttons shall be of the touch button type with brass faceplate to match interiors of passengers lift. Buttons shall be non-moving type operated by body heat when pressed.

2.6.3 CAR FINISHES

Service lifts shall be provided with: Pressed Stainless steel Finished in Lacquer completely illuminated, kick plates, stainless steel handrails, chromium plated touch buttons as per manufacturer's products.

All passenger lift shall be provided with the following:

Doors (Internal and External) Pattern – Stainless steel.

Walls Pattern – as shown in schedules.

Transom panel – pattern – painted steel sheet.

Normal lift rods shall be at 120 cm.

Ceiling as described in schedule.

Lighting – downlights and indirect lighting.

Kick plate – stainless steel hairline.

Flooring – as described in schedule.

Car operating panel – Similar to CBH – N210 from MITSUBISHI stainless steel hairline.

2.6.4 **LANDING DOORS**

Landing doors of lifts shall be of the sliding, automatic, power operated center opening type, of hollow metal construction, packed with fire resistant filling. Doors shall operate silently and their hangers and tracks shall be of the two point suspension ball or rolling bearing type. Doors shall be guided at the bottom by gibs in a groove in an approved type sill. The grooves and tracks shall be so designed that they are automatically cleaned by the operation of the doors.

- a) Doors shall stay open as long as the beam is cut off.
- b) Doors close as soon as the beam flux is restored and after the door time.
- c) If beam is cut off during closing the doors, doors re-open immediately and stay opened to the restoration of the beam flux and the end of door time.

The landing doors shall have such interlocks as to prevent operation if the lift doors are open. Also it shall not be possible to open any landing door until the car arrives and stops at the landing. In case of interruption or failure of electric power, provision must be made for opening all landing doors by a special key.

The doors shall normally open automatically once the car reaches and stops at the required floor. The doors shall then remain open for a reasonable adjustable period of time to enable passengers to enter or leave the car.

The landing doors comprise one indirectly mechanically linked panel (by rope), (other panels) closed position, not locked by the locking device shall be interlocked by an electric safety device as per EN81-7.7.6.2.

Should the electric power fail, the door operator shall be designed that the doors can be manually opened from within the car.

Each landing entrance shall be fitted with a self-contained unit for supporting the door panel. Each unit shall consist of a sill, two angle uprights and header. A suitable non-

slip sill shall be installed at each landing and car entrance. The sill shall be made of stainless steel or aluminum to approved texture.

All doors shall be stainless steel with hairline finish, unless otherwise instructed by the Engineer.

2.6.5 **CAR DOORS**

Car doors shall be provided according to CEN (EN 81).

Car doors construction and finish shall be similar to the landing doors; they shall be mechanically connected and shall move simultaneously in opening and closing.

Fire rating of doors shall be for two hours.

PART-3-EXECUTION

3.1 **INSPECTION**

- A. Study the Contract Documents with regard to the work as shown and required so as to insure its completeness.
- B. Examine surface and conditions, which this work is to be attached or applied, and notify the Architect in writing, if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.
- C. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions, which are at variance with those on the accepted shop drawings to the attention of the Architect. Obtain the decision regarding corrective measures before the start of fabrication of items affected.
- D. Cooperate in the coordination and scheduling of the work of this section with the work of other sections so as not to delay job progress.

3.2 **INSTALLATION**

Install the elevators, using skilled workmen in strict accordance with the final accepted shop drawings and other submittals

Comply with the code, manufacturer's instructions and recommendations.

Coordinate work with the work of other trades for proper time and sequence to avoid construction delays and to insure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.

Accurately and rigidly secure supporting elements within the shaftways to the encountered construction within the tolerance established.

Provide and install motors, switches, controls, safety and maintenance and operating devices in strict accordance with the submitted wiring diagrams and applicable codes and regulations having jurisdiction.

After installation touch up, in the field, surfaces of shop primed elements, which have become scratched or damaged.

Lubricate operating parts of system as recommended by the manufacturer.

3.3 **PROTECTION AND CLEANING**

Adequately protect surfaces against accumulation of paint, mortar, mastic and disfiguration or discoloration and damage during shipment and installation.

Upon completion, remove protection and thoroughly clean work and have it free from discoloration, scratches, dents and other surface defects.

The finished installation shall be free of defects. Before final completion and acceptance of the building, repair and/or replace defective work, to the satisfaction of the Architect and the Owner at no additional cost.

SCHEDULE NO. 1**GENERAL REQUIREMENTS****LIFT SUMMARY**

LIFT No”	: L1 & L2
TYPE	: Passenger
No OF PASSENGERS	: 10
LOAD	: 750 Kgs
SPEED M/S	: 2 m/sec
LEVELLING ACCURACY	: +6mm
MACHINE ROOM LOC	: Machine room above
POWER DRIVE	: VVVF
OPERATION	: Simplex full collective selective.
TRAVEL	: Approx. 21m or as shown on drawing
No" OF STOPS	: 6
No" OF OPENINGS	: 6
DOORS TYPE	: Automatic Central Side Opening
DOORS OPENING W x H	: 90cmx210cm
HOISTWAY WxD	: 200cm x 2000cm.
CAR DIMENSIONS	
WIDTH	: 140cm
DEPTH	: 130cm
POWER SUPPLY	:400V-3 phase-50 Hz
SAFETY GEAR	: Progressive Safety and oil buffers
COMPENSATION ROPES	: Required
CAR FINISHES	: Suspended illuminated ceiling with florescent light as approved by architect. Floor: Vinyl Walls: Painted steel walls type D-100 with full height mirror panel on rear wall Sill: Stainless steel