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1. PRELIMINARIES

1.1 Standard and Codes

1.1.1 The Contractor shall, perform the Works in compliance with all regulations, standard specifications or statutes of the Government of Maldives unless otherwise conform to this specification.

1.1.2 The current British Standard Specifications and Codes of Practice shall apply to and form part of these specifications unless otherwise specified in respect of all materials and works to which they have application.

1.2 Drawings and Specifications

1.2.1 Drawings and Specifications are intended to complement each other, so that if anything is shown on the Drawings, but not mentioned in the specifications or vice versa, it is to be furnished and built as though specifically set forth in all three. If any discrepancies, errors, ambiguities or omissions occur in the Drawings or Specifications, the same shall be referred to the Consultant before proceeding with the Works, and the Consultant decision on such discrepancies, errors, ambiguities or omissions shall be final.

1.2.2 In addition to the Drawings and Specifications attached hereto, the Consultant will during the progress of the Works furnish additional Drawings, Specifications, and instructions as may be necessary, in the opinion of the Consultant for the purpose of the proper and adequate execution and maintenance of the Works, and the Contractor shall make his work conform. Such drawings and instructions shall be deemed to be part of the Contract Documents.

1.3 Transportation to the Site

1.3.1 The Contractor shall provide all necessary transport, handling and storage of all materials, components and the like to their points of installation on site including transport to and from storage. The Contractor shall provide all necessary transport of labour to and from the site.

1.4 Schedule and Execution Plan

1.4.1 The Contractor shall prepare and submit to the Consultant for approval the construction schedule and an execution plan of temporary facilities, stockyards, etc., before the start of the Works.

1.5 Repairing and Correction

1.5.1 Any breakage(s) or defect(s) of existing buildings, road utilities, or part(s) of them caused by the Works including transportation for the works shall be repaired or corrected by the Contractor with his responsibility.

1.6 Workmanship and Materials

1.6.1 All workmanship shall be of the best standard. All goods and materials to be incorporated in the Works must be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract.

1.6.2 The Contractor shall submit for the approval of the Consultant a list of names and addresses of the manufacturers and trade marks or names of all the various types of materials and

goods he propose to use in the Works. The list shall include reference to the specifications clause or article to which the materials and goods apply.

1.6.3 Materials shall be obtained from approved sources and used in accordance with the manufacturer's printed instructions. In the absence of a specification all materials shall comply with a relevant standard. The consultant shall order the removal of any materials, which he has not approved.

1.6.4 No orders for materials and goods shall be placed until approval has been obtained for the materials and goods from the consultant.

1.6.5 The Contractor shall note that it is his responsibility to include in his price for the cost of the materials and products as specified and no adjustment will be allowed should the consultant reject the alternatives.

1.7 Obvious Work

1.7.1 Where an item of work is obviously required for the type of work being undertaken then it shall be deemed to have been included even though the item is not specifically mentioned or shown in the Drawings or Specifications.

1.8 Protection

1.8.1 The Contractor shall have the Works and adjoining properties protected from inclement weather. Any loss or damage caused by weather, carelessness or lack of skill of workers, accident or otherwise shall be of such property that is affected. The Contractor shall provide all necessary dustsheets, barriers and guardrails and clear away at completion.

1.8.2 The work shall be suspended for such time as may be directed and/or approve by the Consultant if the specified quality of work is difficult to maintain during inclement weather.

1.9 Scaffolding

1.9.1 The Contractor shall provide, erect, maintain, dismantle and clear away at completion proper and adequate including that required for subcontractor and suppliers. Putlog holes shall be made good to match the adjacent surface as the scaffolding is dismantled.

1.9.2 The Contractor shall be responsible for all safety precautions in connection with the scaffolding including the provision of all bracing, scaffold boards, toe boards and the like and for entire sufficiency for the work.

1.10 Construction Machinery, Plants and Equipment's

1.10.1 All necessary construction machines shall be provided and maintained by the Contractor and shall be approved by the Consultant.

1.10.2 If cranes or any other type of plant which places any load on the structure are proposed, all details of such plant shall be submitted to the Consultant for approval before the work is actually commenced. If approved by the Consultant and contractually acceptable, permission may be given for the structure to be strengthened, in order to carry out loads, and the Contractor shall be responsible for any resulting additional costs.

1.10.3 The Contractor shall be responsible for making good to the satisfaction of the Consultant any damage to the permanent structure that may be caused by his plant and equipment.

1.11 Samples

1.11.1 The Contractor shall furnish for the approval with reasonable promptness, all samples as directed by the consultant. The Consultant shall check and approve such materials with reasonable promptness only for conformance with the design concept of the Works and for compliance with the information given in the Contract Document. The Work shall be in accordance with the approved samples

1.11.2 All samples shall be delivered to the Consultant's office with all charges in connection therewith paid by the Contractor and deemed to be included in the Contract Price.

1.11.3 Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Consultant, one for office use and one for the site.

1.11.4 Samples shall be furnished so as not to delay fabrication, allowing the consultant reasonable time for consideration of the sample submitted.

1.11.5 Each sample shall be properly labelled with the name and quality of the material, manufacturer's name, name of project, the contractor's name and date of submission, and the specification clause to which the sample refers.

1.12 Ordering Materials

1.12.1 The Bills of Quantities shall not be used as a basis for ordering materials and the Contractor is entirely responsible for assessing the quantities of materials to be ordered.

1.12.2 Upon receipt of the Consultant's order to commence the Works, the Contractor shall immediately place orders for all required materials and will be held responsible for any delays occurring due to late placing of such orders.

1.12.3 The Contractor shall pay all expenses, taxes and dues etc. incurred on the procurement of materials from abroad

1.13 Water and Electricity for the Works

1.13.1 The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport, temporary plumbing, storage and distribution, pay all charges and alter, adept and maintain temporary work as necessary and remove and make good at completion.

1.13.2 The Contractor shall make all necessary arrangements and provide all artificial lighting and power (maintain a generator if necessary) for the proper execution and security of the Works and its protection, with all meters, temporary wiring and fittings, pay all charges and alter adapt and maintain the temporary work as necessary and remove and make good at completion.

1.14 Site Offices for Contractor

1.14.1 The Contractor shall provide maintain and clear away on completion of the Contract all necessary site offices, canteens, messing and welfare facilities, temporary buildings, toilets and the like for all site staff employed by the Contractor and required by subcontractors and suppliers.

1.14.2 The offices shall be open at all normal working hours to receive instructions, notices and other communications.

1.14.3 The Contractor shall obtain the approval of the Consultant of the proposed site layout, type and drainage arrangement of all the buildings prior to erection of same. All buildings shall be supplied and maintained in good condition and of neat appearance, all maintenance to same as instructed by the Consultant shall be carried out at the Contractor's expense.

1.14.4 Under no circumstances shall overnight accommodation be permitted on Site except for the site watchman in carrying out his duties.

1.15 Contractor's Site Area

1.15.1 Throughout the period of the Contract the Contractor shall maintain the area of his operation within the limits of the Site in a clean, tidy and safe condition by arranging materials and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the Site as it accumulates.

1.15.2 The Contractor shall take all steps necessary as directed by the Consultant to minimize or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted.

1.16 Progress Meetings

1.16.1 During the course of the Works, progress meetings shall be held at fortnightly intervals for the purpose of co-ordinating the Contractor's works and to ensure that full compliance is maintained.

1.16.2 Minutes of such meetings should be recorded; copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein.

1.16.3 Prior to such meetings the Contractor shall give to the Consultant's Representative details in writing of that portion of the Works he proposes to construct during the coming two weeks with details of the plant and method he proposes to employ. These proposals shall be discussed at the meeting and no work based on such proposals shall proceed without the approval of the Consultant's Representative.

1.16.4 The Contractor shall submit all reports as instructed by the Consultant in connection with progress meetings and the day to day management of the Works.

1.17 Progress Photographs

1.17.1 The Contractor shall supply once a month, at the time of submitting his Interim Certificates, twelve photographs from 36 exposures showing the progress of the Works. The Consultant shall direct the times and position from which the photographs are to be taken.

1.17.2 The photographs shall be submitted in three copies un mounted of a size not less than 15 x 10 centimetres with the description of the viewpoint stamped in ink on the back. The negative shall have the date on it and remain the property of the Consultant and no prints from these negatives may be supplied to others unless previously authorized in writing by the Consultant.

1.18 Setting Out

1.18.1 The Contractor shall be responsible for accurately setting out the Works to the specified positions, dimension, levels and Building Lines and also checking the site surveys for dimensional and level accuracy and reporting any discrepancies before building work commences.

1.18.2 The Contractor shall provide the Consultant with all facilities, equipment and labour to enable him to check the setting out and levels of the Works at all times. The checking of any setting out point, line or level by the Consultant shall not in any way relieve the Contractor of his responsibility

1.18.3 All setting out points, benchmarks, site rails, pegs and other survey points shall be clearly marked and protected from damage or disturbance during the execution of the Works

1.19 Billboards

1.19.1 The Contractor shall provide and maintain two billboards for the Site each consisting of a plastic board panel of size not more than 2.4m x1.2m (2.88m^2) supported 2.5m above the ground with steel angle framing or similar material and fixed in concrete foundations.

1.19.2 Each board shall have the following written in both Dhivehi and English (letter height not to exceed 100mm) by a skilled sign writer:

The name of Project

The name of Employer

The name and address of Consultant

The name and address of Contractor

1.19.3 A scaled layout shall be prepared and submitted for the Consultant's approval before fabrication.

1.19.4 No advertising material other than the above will be permitted.

1.19.5 The location and layout of Sub-Contractors or Manufacturer's billboards, if allowed, must be submitted for the Consultant's approval.

1.20 Loading in Excess of Design Load

1.20.1 No loading in excess of the design loading shall be placed on any portion of the structure without the written permission of the Consultant

1.20.2 If such permission is granted, all beams or other members of the structure which are subjected to loading other than the designed loading shall be strengthened and supported to the satisfaction of the Consultant, and the Contractor shall be responsible for any resulting additional costs

1.20.3 The Contractor shall be responsible for making good to the satisfaction of the Consultant any damage to the permanent structure that may be caused by such excess loading.

1.21 Building Permit

1.21.1 The Contractor shall allow for obtaining the building permit and for paying all fees in connection therewith.

1.22 Permanent Drainage, Electricity and Water connection

1.22.1 The Contractor shall allow for arranging and obtaining the permanent drainage, water and electricity connections to the proposed development and he shall be responsible for making all payments in connection therewith.

1.23 Handing Over

1.23.1 Prior to handing over the proposed development the Contractor shall gain the approvals and respective Completion Certificates from all the local government authorities and the like that the work has been completed in accordance with their requirements. Any payment in connection therewith shall be paid by the Contractor.

2. SITE WORKS

2.1 Demolition

2.1.1 Demolition includes the complete demolition including grubbing up of foundations and the proper termination of all services as required by the Drawings including the removal and disposal of all demolished materials. The demolition work shall be executed in a systematic manner.

2.1.2 Demolition operations and the removal of debris shall be carried out to ensure minimum interference with roads, streets, footpaths and other adjacent occupied or used facilities.

2.1.3 Damage caused to adjacent facilities by demolition operations shall be repaired by the Contractor at his own expense. The Contractor shall arrange and pay for the disconnecting, removing and capping of utility services, notify the affected utility agency in advance and obtain written approval before commencing work.

2.1.4 Before commencement of work, submit a method statement to the Consultant as to the proposed method and sequence of demolition of the building and a safety plan which shall cover the risk assessment and safety measures for such method statement. The Consultant reserves the right to prohibit any method of execution of the Works which he regards as unsafe.

2.1.5 Drawing information, particularly for unconventional layouts and special structures, will be made available to the Contractor if possible. The Contractor shall state in his method statement if it is based on such drawings. In the absence of drawings, the Consultant may require a detailed structural survey to be carried out and endorsed by a Registered Structural Engineer (or equivalent) to define the existing structure and the appropriate method and sequence of demolition.

2.1.6 No work on site shall be allowed to commence until the proposed method statement has been accepted and all precautionary measures, hoardings, covered walkways, and other requirements are in place.

2.2 Site Clearance

The Site shall be cleared of all vegetation, rock, boulders, etc. and surface soil shall be removed as directed by the Consultant. The trees which are to be retained shall be protected from damage

Spreading, levelling and consolidating on site where required, shall be made with suitable surplus excavated material obtained from the Site. Other soils used for filling shall be approved by the Consultant

The Contractor shall dispose all unsuitable and surplus excavated material

The Contractor shall tidy up and leave the Site in a clean and sanitary condition at all times during the execution of the Works.

2.2 Excavation

2.2.1 Excavation shall be performed to the required depth as shown in the Drawings.

2.2.2 A survey of the existing site shall be made and the results of same submitted to the Consultant before commencement of the work

2.2.3 Excavation area shall be protected from any water flowing in. Sides of excavations shall be shored or inclined to retain excavation unless otherwise specified

2.2.4 Excavation near adjoining structures shall be executed with care so as not to damage those structures.

2.2.5 The Contractor shall take all necessary precautions during the excavation for the Works particularly those excavation which are adjoining existing buildings and shall protect such buildings from the damage or collapse by means of temporary or permanent shoring, strutting, sheet piling or underpinning or excavation in short lengths and/or other methods as he deems fit and also he shall properly support all foundations, trenches, walls, floors, etc. affecting the safety of the adjoining existing buildings.

2.2.6 The Contractor shall alter, adopt and maintain all such works described above for the whole period of the Contract and shall finally clear away and make good all damages done.

2.2.7 The construction and efficiency of the shoring, underpinning, strutting and the like for the purpose for which it is erected shall be the responsibility of the Contractor, should any subsidence or any other damage occur due to the inefficiency of the shoring, underpinning, strutting and the like or any other support provided, the damage shall be made good by the Contractor at his own expense and responsibility.

2.2.8 The shoring, strutting, piling and the like, shall be executed in such a manner as to cause as little inconvenience as possible to adjoining owners or the public and the Contractor shall be responsible for negotiating with the adjoining owners the means to safeguard their property and for the use of any portion of their land for the purpose of executing the excavations and no claims submitted on this ground will be entertained.

2.2.9 The Contractor shall be held solely responsible for the safety of the adjoining existing buildings, the sufficiency of all temporary or permanent shoring, underpinning, piling, and the like.

2.2.10 The Contractor shall keep the Consultant informed as to manner in which he intends to proceed with the execution of the excavations and obtain his approval. Such approval if given shall not absolve the Contractor of his responsibility.

2.2.11 Excavation shall extend a sufficient distance from walls, footings, etc. to allow space for placing and removing shoring and formwork, for performing all work in the excavations and for the inspection ofsame.

2.2.12 Excavated material shall be deposited within specified areas as directed unless otherwise specified.

2.2.13 The Contractor is deemed to have inspected the site and to leave ascertained for himself as to the nature of the soil, etc. and also the areas where to collect and stack the materials for which necessary site clearance shall have to be made at his own cost.

2.2.14 Stacking or excavated materials shall be done at places approved by the Consultant and he shall have recorded the original ground levels of such places jointly with the Contractor before commencement of stacking operation.

2.2.15 Extra excavation and allied lead/lift required specifically for providing working space to workmen or shuttering to walls of basement etc. shall be measured for payment, no extra claim being allowed for such work incidental to development and executions of allied jobs. Only authorized excavation approved by the Consultant shall be paid for

2.2.16 Sufficient clear working space shall be left all around excavated area. The disposal of waste/unserviceable materials may be in filling and/or in embankment according to nature of place of disposal. The appropriate specifications for filling and/or embankment shall apply

2.2.17 All foundation trenches shall be excavated to the full widths and depths shown on the drawings or to such greater or smaller depths as may be found necessary in the opinion of the Consultant and so instructed by his representative.

2.2.18 Should any excavation be taken down below the specified levels, the Contractor shall fill in such excavation at his own cost with cement concrete specified for foundations, well rammed in position until it is brought up to the level.

2.2.19 The Contractor shall notify to the Consultant when the excavation is completed and no concrete or masonry shall be laid until the Consultant has inspected of the soil for each individual footing.

2.2.20 All foundation pits shall be refilled to the original surface of the ground with approved materials, which shall be well consolidated as instructed by the Consultant.

2.2.21 The Contractor shall erect temporary barricades around the excavations and if necessary make provisions of red lamps.

2.2.22 The Contractor shall remove/maintain/restore all service lines like telephone, water supply, electricity etc. without any extra charges.

2.3 De-watering

2.3.1 Where the excavation level is below the natural water table and it is necessary to pump continuously from the excavation or to install a specialist type of dewatering equipment around the perimeter of the site or excavation, the Contractor will be responsible for ensuring the safety and stability of all adjoining structures and services or utilities above or below ground level.

2.3.2 It will also be the responsibility of the Contractor that the equipment installed shall ensure that the excavation and subsequent construction is carried out in dry conditions.

2.3.3 Continuous or permanent de-watering of the excavation or Site may not be undertaken without the written approval of the Consultant and the methods to be employed shall also comply with Codes of Practice and Local Authority requirements.

2.3.4 The water pumped from the excavations or well points shall be pumped to disposal points or sumps approved by the Consultant and the Local Ward Office and if so required be passed through settling tanks before disposal.

2.3.5 Unless prior approval has been obtained no water must be disposed of in the Municipality's sewer systems.

2.4 Backfill

2.4.1 All earth used for filling shall unless otherwise stated, be selected hard dry material. The maximum dry density of the fill material shall be not less than 1600 kg/m^3.

2.4.2 The backfill of excavations shall be placed in horizontal layers not exceeding 300mm in thickness. Each layer shall be compacted by hand or other mechanical means to the required density before the next layer is added

2.4.3 Care shall be taken when filling or back-filling to avoid any wedging action or eccentric action upon or against the structure of the work.

2.4.4 Before placing of fill, the surface of the sub-grade shall be compacted at optimum water content to the same percentage of maximum dry density required of subsequent lay.

2.4.5 The Consultant will inspect all compacting devices that the Contractor proposes and shall have the right to reject any device which he feels is unsuitable for the job.

2.4.6 Heavy equipment for spreading and compacting fill and backfill shall not be operated closer to walls than a distance to the difference in height between the top of the footings and the layer beingcompacted.

2.4.7 When back-filling behind retaining walls, basement walls and the like the said structures shall be kept propped during the complete operation. The hydraulic compaction of fill shall not be permitted and the back filling shall be carried out in layers not exceeding 150mm thick.

2.4.8 Each layer shall be compacted to 90% of the modified compaction. No back filling shall be carried out until the wall concrete has achieved its full works cube strength and care shall be exercised so as not to damage the external tanking membrane and its protection.

3. CONCRETE WORKS

3.1 General

3.1.1 Materials used in the Works shall be new, of the qualities and kinds specified herein and equal to approved samples. Delivery shall be made sufficiently in advance to enable further samples to be taken and tested if required. No materials shall be used until approved and materials not approved shall be immediately removed from the Works.

3.1.2 Materials shall be transported, handled and stored on the site or elsewhere in such a manner to prevent damage, deterioration or contamination.

3.2 Cement

3.2.1 Cement shall be Ordinary Portland cement of an approved brand.

3.2.2 Cement shall conform to BS 12.

Cement shall be of recent manufacturer and used within 6 months of manufactured date.

The Contractor shall with each fresh consignment of cement delivered to the site furnish the Consultant with a copy of the Manufacturer's statement of compliance with the above Standard Specifications together with the date of manufacture, certified by an independent agency in the country of origin and its date of delivery to Site.

Check tests will be required by the Consultant. These tests shall be carried out at the Contractor's expense.

Any cement failing to meet the required standards will be rejected and replaced at the Contractor's expense.

Any cement not conforming to BS 12 shall not be used unless otherwise approved by the Consultant.

3.3 Aggregate

3.3.1 Fine aggregate shall be river sand conforming to BS 882.

3.3.2 Coarse aggregate shall be crushed stone excluding limestone or derivatives of limestone conforming to BS812.

3.3.3 Aggregate shall not contain injurious amount of rubbish, dirt, organic impurities and other foreign matters.

3.3.4 Strength of aggregate shall be more than that of hardened concrete paste.

3.3.5 Shape of coarse aggregate shall not be flat or slender.

3.3.6 Aggregate to be used in concrete shall possess the qualities indicated in the following tables.

Quality of Aggregates

Aggregate type	Open dry specific gravity	Percentage of water absorption (%)	Percentage of solid volume for the evaluation of particle shape (%)	Clay lump (%)	Loss in washing test (%)	Organic impurity (%)	Water soluble chloride (%)
Coarse aggregate	<= 2.5	<= 3.0	=> 55	<= 0.25	<= 1.5	0	<= 0.25
Fine aggregate	>=2.5	<= 3.5	-	<= 1.0	<= 3.0	0	<= 0.01

* Colour of test solution not to be darker than standard solution

Grading requirements for aggregates

Percentage passing each sieve by weight (%)

Agg.	Max. size (mm)	Nominal sieve size (mm)											
		40	30	25	20	15	10	5	2.5	1.2	0.6	0.3	0.15
Coarse	25	100	100	90 - 100	60 - 90		20 - 50	0 - 10	0 - 5				
	20			100	90 - 100		20 - 55	0 - 10	0 - 50				
Fine							100	90 - 100	80 - 100	50 - 90	25 - 65	10 - 35	2 - 10

.3.7 Manufactured sand and blast furnace slag to be use in concrete shall not be used unless otherwise specified or approved by the Consultant.

3.3.8 In case of using fine aggregate of 0.01% or more water soluble chloride content, the necessary measures for corrosion inhibiting of reinforcement shall be instructed by the Consultant.

3.3.9 The maximum size of coarse aggregate shall be 25 mm.

3.3.10 Sources of aggregate shall be to the approval of the Consultant and samples of aggregate from the proposed source shall be submitted to the Consultant at least 28 days before its intended use.

3.4 Water

3.4.1 Water shall not contain injurious amount of impurities that may adversely affect concrete and reinforcement.

3.4.2 Ground water shall not be used for concrete works.

3.4.3 Water shall be obtained from a public supply where possible, and shall be taken from any other sources only if approved by the Consultant.

3.4.4 Only water of approved quality shall be used for washing out formwork, curing concrete and similar surfaces.

3.5 Handling and Storage of Material

3.5.1 Cement

3.5.1.1 Cement shall be stored in a manner to prevent weathering.

3.5.1.2 Bagged cement shall be piled no more than 10 bags so as to permit easy inspection

3.5.2 Cement caked even to the slightest extent shall not be used. Such cement and rejected cement shall be immediately separated from other bags of cement so that they shall not be mistaken for others.

3.5.3 Aggregate

3.5.3.1 Aggregate shall be stored in a manner effectively separating coarse and fine aggregate according to type and shall be prevented from inclusion of dirt, rubbish and other undesirable foreign matters.

3.5.3.2 Coarse aggregate shall be unloaded and piled in a manner not to cause segregation of small and large particles. Aggregate to be stored in piles shall be in mounds of moderate height and at a location where good drainage is provided.

3.6 Mix Proportion and Strength

3.6.1 Mix ratio for reinforced concrete shall be in the proportion 1:2:3 (cement: fine aggregate: coarse aggregate) by dry volume.

3.6.2 Mix ratio for lean concrete shall be in the proportion 1:2:6 (cement: fine aggregate: coarse aggregate) by dry volume.

3.6.3 Water-cement ratio for concrete shall be 0.4% to 0.45%

3.6.4 The specified design strength of reinforced concrete shall be 25 N/mm²

3.6.5 The required slump of concrete shall be 100 mm.

3.6.6 Design mix proportion shall be to obtain required workability, consistency and durability.

3.7 Production of Concrete

3.7.1 Field-mixed Concrete Plant

3.7.1.1 The Contractor shall select the necessary facilities for storage, batching, mixing and transporting of each of the materials and submit them for approval of the Consultant prior to start work.

3.7.2 Measuring

3.7.2.1 All materials shall be measure by volume for each batch and water may be measured volumetrically.

3.7.2.2 Cement shall be measured by number of bags unless automatic cement weight measure is in use.

3.7.3 Mixing Control

3.7.3.1 Concrete mixture shall be constantly controlled to obtain required workability and mixed strength. Mixing time for each batch shall be not more than 3 minutes.

3.7.4 Quality Control

3.7.4.1 The Contractor shall conduct tests for quality control toward insuring that concrete of the required quality is constantly produced.

3.7.4.2 The Contractor shall have all quality control tests report ready for submission as required by the Consultant.

3.7.5 Quality Inspection of Concrete at the Point of Placement

3.7.5.1 The Contractor shall conduct tests on concrete at the point of placement. When test results meet the tolerances given below, the concrete shall be qualified to have passed the tests.

The tolerance between actual slump and required slump of the concrete shall be 2.0 mm

3.7.5.2 For the estimation of compressive strength of concrete in compressive strength tests, when the average value of compressive strength of concrete obtained in a test is not less than the specified design strength, it shall be qualified to have passed the test. In case of failure to the above requirements, the Contractor shall take necessary measures such as to perform appropriate test as instructed by the Consultant.

3.8 Transporting and Placing

3.8.1 General

3.8.1.1 The Contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Consultant.

3.8.1.2 Concrete shall be transported in a manner to minimize segregation, spill, age and other changes in quality thereof.

3.8.1.3 Concrete shall be placed and consolidated in a manner to insure uniformity and optimum density.

3.8.1.4 In case of rain or other conditions that may affect the quality of concrete during concreting, the Contractor shall take necessary measures as instructed by the Consultant.

3.8.2 Time Limit

3.8.2.1 The time limit from start of mixing to completion of placing of a batch as a rule shall be 30 minutes.

3.8.3 Preparation prior to Placing.

3.8.3.1 The place where concrete is to be deposited shall be cleaned and sheathing shall be sprinkled with water. Subsequently, water accumulated in the form shall be removed.

3.8.4 Construction Joint

3.8.4.1 Joint surfaces shall be cleaned, made free of laitance and other foreign matters, and wetted prior to concreting. Joint surface shall be roughened if directed by the Consultant.

3.8.4.2 The locations of shapes of construction joints shall be consulted and approved by the Consultant.

3.8.5 Concrete Placing

3.8.5.1 Concrete placing shall be proceeded to keep the surface of placed concrete as horizontal as possible.

3.8.5.2 Concrete shall be continuously poured to compact around reinforcing bars and corners of formwork.

3.8.5.3 The maximum time interval between placements of continuous concreting shall not exceed 0.5 hours. However, when special measures are taken this time limit may be changed according to instruction or approval of the Consultant.

3.8.6 Consolidation

3.8.6.1 Vibrating of concrete and tapping of formwork shall be performed to wall, column and other places difficult for concrete to proceed. Proper number of workers for placing and compacting concrete shall be arranged.

3.8.6.2 Vibrator shall be operated for concrete called for water tightness, difficult portion for concrete to proceed and other cases directed by the Consultant. However, vibrator shall not be touched reinforcing bars and shall not be operated more than 30 seconds at same spot.

3.8.6.3 Concrete shall be placed 300 - 600 mm thickness at once in case vibrator is performing. In case flexible-insert-vibrator is called for, concrete shall not be placed thicker than the length of the insert or vibrator at one pouring.

3.8.7 Placing Speed

3.8.7.1 Concrete shall be placed at the speed suited for the workability of the concrete and condition of the place of placement, which insures proper consolidation ofconcrete.

3.9 Concrete Curing

3.9.1 Curing Method

3.9.1.1 After concrete has been placed, the concrete surface shall be kept moist by sprayed with water or by other appropriate methods, and shall be protected from direct sunlight and rapid drying. The top surface of slabs shall be kept flooded with water at all times after concreting for the duration of curing period. This curing period shall be for not less than 14 days.

3.9.1.2 As a rule, no foot traffic or loads shall be permitted on concrete for at least 24 hours after placement.

3.10 Test

3.10.1 General

3.10.1.1 The contractor shall be required to conduct all tests according to BS method and procedure.

3.10.1.2 Test, as a rule, shall be conducted at the locations directed or at the testing institutions approved by the Consultant.

3.10.1.3 The Consultant shall conduct test, as a rule.

3.10.1.4 In case of failure in test, measure shall be taken as instructed by the Consultant.

3.10.1.5 The Contractor shall keep test records during the work and for 2 years after completion of the contracted work.

3.10.2 Material

3.10.2.1 Cement Test

(1) Setting test.
(2) Soundness test.
(3) Compressive strength test.

Note: Item (1) shall be conducted once in every manufacturer.
Item (2) & (3) shall be conducted once in every 2,000 bags.

3.10.2.2 Aggregate test:

(1) Grading and fineness modules.

3.11 Concrete

3.11.1 Fresh concrete

Slump, air content, shall be conducted daily, and more often at request of the Consultant.

3.11.2 Compressive strength test of concrete

Test for estimation on strength of concrete in structure:

3.11.2.1 In order to assume estimated strength of concrete in structure, compressive strength test shall be conducted for prepared test pieces on the 7th day and 28th day and those test pieces shall be made for sampling at placing of concreting.

3.11.2.2 Strength test shall be conducted for each of the following conditions: each days pour, each class of concrete, each change of supplies or source and each 100 cubic meter of concrete or fraction thereof. The number of test pieces to be used in a test shall be not less than 3 for each test of the 7th day and the 28th day unless otherwise instructed by the Consultant.

3.11.2.3 Test pieces shall be made in accordance with British Standards, and sampling shall be taken as near as possible at the point of placement.

3.11.2.4 Test pieces shall be stored without being disturbed and shall be covered during the first 24 hours, and carefully transported specimens to the testing laboratory. Test pieces shall be cured in water after de-moulding. The temperature of test pieces shall be kept as close as possible to the temperature of the concrete in structure until the time of testing.

3.11.2.5 The test results shall be expressed in the average value by calculating the average compressive strength of all test pieces. The average value must be equal to or greater than the specified strength.

3.12 Defective Concrete and Finishes

3.12.1 Honeycombed surfaces shall be made good or on the instruction of the Consultant be cut out by the Contractor and make good at his own expense.

3.12.2 Concealed concrete faces shall left as from the formwork except honeycombed surfaces shall be made good. Faces of concrete to be rendered shall be roughened by approved means to form a key. Faces of concrete that are to have finished other than those specified shall be prepared in an approved manner as instructed by the Consultant

4. CONCRETE FORMWORK

4.1 Structure and Material

4.1.1 Structure

4.1.1.1 Formwork shall be performed to obtain accurate concrete in accordance with the designated drawings.

4.1.1.2 Formwork shall be firmed and secured to bear the force of concreting and tightened to avoid cement paste seeping.

4.1.2 Materials

4.1.2.1 Sheathing for formwork shall be waterproof plywood of not less than 12 mm thick. Joint of sheathing shall be butt joint and firmly assembled. In case of

using wood board for sheathing, boards shall be 15 mm thick and applied planer. Joint shall be tongued and grooved unless otherwise approved by the Consultant.

4.1.2.2 Form liners shall be sound and suitable materials to accurately and safely cast the in-situ concrete structure as shown on the Drawings.

4.1.2.3 Timber form boards for sheathing where used for fair-faced concrete shall be of such new materials as not to cause any defects to the surface of the concrete. Special care shall be taken in fabrication, storage and protection of these boards.

4.1.3 Other Material

4.1.3.1 Fastening hardware to be used shall be those with allowable tensile strength guaranteed by manufacturer through strength tests.

4.1.3.2 Form oil shall not have injurious effects on quality of concrete nor to bonding of surface finishing materials and shall be subject to approval of the Consultant.

4.2 Performance

4.2.1 Design of formwork

4.2.1.1 Formwork shall be designed to withstand construction leads during concreting, lateral pressure of fresh concrete, shock and vibrators due to concrete placing.

4.2.1.2 Formwork shall be free of injurious leakage of water, easy to remove, and shall not damage concrete at removal.

4.2.1.3 Supports shall be provided with the adequate horizontal and diagonal bracing and/or stays to prevent collapsing, heaving and twisting of formwork due to horizontal loads working during concrete placing.

4.2.2 Tolerance

The dimensional tolerances in location and cross section of concrete member used for designing and construction of formwork shall conform to the following table.

Standard Values of Dimensional tolerances

Item	Tolerance (mm)
Tolerance in distance from datum line of each floor to respective members	+ 10
Tolerance in cross section of columns, beams and walls	- 5 , + 10
Tolerance in thickness of floor and roof slabs	0, +10

4.2.3 Fabrication and Erection

4.2.3.1 Erection of formwork, and transportation and storage of materials thereof shall be started only after previously placed concrete has reached an age which acceptance of these loads will not have any adverse effect on the concrete.

4.2.3.2 Sheathing shall be fabricated and installed accurately to match the locations, shapes and dimensions of members called for in the Drawings.

4.2.3.3 Sheathing shall be installed tightly so as not to permit cement paste or mortar to escape from joints.

4.2.3.4 Pipes, boxes and other embedded hardware shall be properly secured to sheathing or others so that they will not move during concrete placing.

4.2.3.5 Supports shall be erected plumb. Supports at any two vertically consecutive floors shall be erected as near as possible to identical locations on a common plane.

4.2.3.6 Shoring shall be erected paying special attention to safety.

4.2.3.7 If sheathing is reused, the surface in contact with the concrete shall be thoroughly cleaned off and sufficiently repaired before reuse. In case of using for fair-faced concrete, the same sheathings shall be used twice after approval of the Consultant.

4.2.4 Inspection

4.2.4.1 Formwork shall be inspected by the Consultant prior to placing of concrete.

4.2.5 Striking of forms

4.2.5.1 The minimum period for keeping the forms in position and for watering after laying the concrete shall be as stated below, except otherwise specified in drawings. Forms shall be removed in such a manner as to ensure the complete safety of the structure, so that there is no shock or vibration as would damage the reinforced concrete.

4.2.5.2 The responsibility for the safety of the concrete shall rest entirely with the Contractor and the Contractor shall be held liable for any damage done and shall have to make good the same at his own expenses.

4.2.5.3 The Contractor shall inform the Consultant when he intends to remove shuttering and shall obtain his consent, but the consent of the Consultant shall not relieve the Contractor of his responsibility.

4.2.5.4 The minimum time for formwork to remain in place shall be as per the following table.

Vertical sides of beams, slabs and columns	24 hours
Soffits of slab	10 days
Soffits of beams	21 days
Cantilevers	28 days

4.2.6 Relocation of Support

4.2.6.1 Supports under concrete shall be not relocated

4.2.7 Removal of formwork

4.2.7.1 Formwork shall be removed gently, after its removal has been approved by the Consultant.

4.2.7.2 Inspection by the Consultant shall be obtained immediately after the removal of sheathing and defects shall be immediately remedied according to instruction of the Consultant.

4.2.7.3 After shoring has been removed, members shall be carefully observed for cracking and deflection, when found, they shall be reported immediately to the Consultant.

5. STEEL REINFORCEMENT

5.1 Material

5.1.1 Reinforcing steel shall be of the dimensions given in the Drawings.

5.1.2 Reinforcing bars shall comply with the requirement of B.S.4449. and welded wire fabric, square bar fabric and expanded metal shall comply with appropriate part of B.S.4483.

5.1.3 Dia 6mm reinforcing steel shall be round mild steel bars, and 12mm, 16mm, 20mm and 25mm shall be deformed high strength bars.

5.1.4 Any other non-specified reinforcing steel shall be used only with the approval of the Consultant.

5.1.5 All reinforcing steel and binding wire shall be stored under cover and shall be at least 250mm above the ground.

5.2 Cleaning

5.2.1 Reinforcing bars shall be cleaned before use so that it is free from rust, oil, dirt or other coatings that reduce bond.

5.3 Bending and Laps

5.3.1 The reinforcement shall be bent cold in an approved bar bending machine.

5.3.2 Preferably bars of full length shall be used. Lapping of bars where necessary shall conform to BS1487 'Bending Dimensions of Bars of Concrete reinforcement.'

5.4 Reinforcement Cover

5.4.1 Concrete cover for reinforcement shall be as follows:

FOR ANY STEEL IN UNDER GROUND CONRETE	50	MM
CLEAR COVER IN SLABS	30	MM
CLEAR COVER IN BEAMS SOFFIT	35	MM
CEAR COVER IN SIDES OF BEAMS	30	MM
CLEAR COVER IN COLUMNS	40	MM

5.5 Placing

5.5.1 Reinforcement intended for contact when passing each other shall be securely tied together with binding wire.

5.5.2 Binders and stirrups shall tightly embrace the longitudinal reinforcement to which they shall be security bound or spot welded.

5.5.3 Binding wire shall be turned in from the formwork and shall not project beyond reinforcing bars.

All reinforcement shall be inspected by the Consultant and approved before concrete is placed in the forms.

6. WATER PROOFING

6.1 Description ofwork

6.1.1 Extent of water proofing work is shown on drawings.

6.1.2 Install slurry type waterproofing to top surfaces of balcony slabs and external surfaces of underground concrete work.

6.1.3 Install crystalline type water proofing to underground water tanks and roof slabs in strict accordance with the approved manufacture's printed instructions.

6.2 Materials

6.2.1 Crystalline Type: Material used shall be a cementatious coating containing catalytic chemicals which migrate in to the concrete using moisture present in the concrete as the migrating medium, and which cause the moisture and the un-hydrated cement in the concrete to react causing the growth of non-soluble crystals of dendritic fibers in the void and capillary tracks of the concrete that allow passage of water, there by rendering the concrete itself water proof.

6.2.2 Acceptable products: Xypex concentrate, modified, ultra plug and quick set as manufactured Xypex chemicals (Canada) Limited (or equivalent).

6.3 Storage ofmaterials

6.3.1 General: All materials shall be stored in original undamaged containers with manufactures seals and labels intact. Material shall be stored off the ground in a dry enclosed area.

6.4 Surface preparation

6.4.1 General: All surfaces shall be examined for form tie holes and defects such as honeycombing, rock pockets, cracks, etc. These areas shall be repaired in accordance with these specifications and the manufactures printed instructions.

6.4.2 Concrete finish: concrete surfaces shall have an open capillary system to provide tooth and suctions shall be clean; free from scale, excess form oil, laitance, curing compounds and other foreign matter.

6.4.3 Smooth surfaces or surfaces covered with excess form oil or other contaminants shall be washed lightly sandblasted, water blasted, or acid -etched with muriatic acid, as required to provide a clean absorbent surfaces.

6.4.4 Horizontal surfaces shall not be troweled or power - troweled, and shall be left with a rough float finish or a broom finish. Vertical surfaces may have a sacked finish. Comply with manufactures specifications for requirements pertaining to minimum 'age' of concrete deck surface scheduled to receive water proofing.

6.4.5 Surface moisture: Water proofing shall be applied to 'green' concrete as soon as possible after forms have been stripped or to older pours which have been thoroughly moistened with clean water prior to application. Free water shall be removed prior to application.

Mixing of crystalline water proofing compound: comply with manufactures specification for 2-coat installation.

6.5 Application

6.5.1 General: Apply all materials under the direction of the manufacturer's representative.

6.5.2 Constructions joints and surface defects: Comply with waterproofing material manufacturer's printed directions in the preparation, and treatment of construction joints and surface defects.

6.5.3 Surface application: After all repair, patching and sealing strip placement has been prepared in accordance with manufacturer's recommendations and approved by manufacturer's representative, treat concrete surface with first coat slurry mix of crystalline waterproofing compound.

6.5.4 Brushing: Use a short bristle or broom to work the slurry well into the concrete, filing all hairline cracks and surface pores.

6.5.5 Second coat: Apply second coat while first coat is still 'green' but after it has reached an initial set, all as recommended by the water proofing material manufacturer.

6.6 Curing

6.6.1 General: Curing shall begin as soon as the waterproofing materials have set up sufficiently so as not to be damaged by a fine spray. Treated surface shall be sprayed three times a day for a three-day period. Allow material to set 12 days before filling the structure with liquid

6.6.2 Protect treated surfaces from damage due to wind, sun, rain and temperatures below 35 degrees F. For a period of 48 hours after application, arrange protections to permit proper curing conditions for waterproofing material.

6.6.3 Clean up: Remove all surplus materials from the premises and leave all areas broom-clean. In the case of temporary protections remove all such items carefully to avoid damage to treated surfaces. Assemble all such materials and remove from premises followed by broom cleaning as noted.

7. EMBEDDED DAMPPROOF MEMBRANE

7.1 General

7.1.1 This section deals with laying of flexible sheet as damp proof membranes or has chemical or vapour barriers embedded in the fabric of the building. It does not deal with the weather-proof roof sheeting, or with vapour barriers.

7.2 Products

7.2.1 Polythene sheets for under slab DPM: gauge 500, manufacturer and reference to approval.

7.2.2 Adhesive tape: A type recommended by the sheet manufacturer.

7.3 Workmanship

7.3.1 Manufacturers Recommendations: to be strictly followed for all products and materials. Apply sheets to clean, dry surfaces with all joints sealed to give a completely water proof continues membrane.

7.3.2 Polythene Sheet Under-Slab Dpm: lay a level bed of fine sand, not less than 13mm thick or as specified to receive membrane.

7.3.3 Polythene Sheet Dpm: ensure that sheets are clean and dry. Lay single layer loose on base, lap edges 150mm and seal with mastic or adhesive tape.

7.3.4 Pipe Etc: where pipe etc. pass through sheeting make junction completely watertight by forming collars fully bonded / sealed to both pipes and sheeting.

7.3.5 Project: finished sheeting adequately and prevent puncturing during following work sheet to be covered by permanent over laying construction as soon as possible.

8. STRUCTURAL STEEL

8.1 Scope

8.1.1 This section shall apply to the work involved with structural steels. All incidental items of structural steel shall be stated in the particular specification.

8.2 Materials

8.2.1 Steel

8.2.1.1 Shape of steel shall be precise and straight and free of injurious scratches and rust.

8.2.1.2 All steel sections shall be galvanized sections of strength class 43 A.

8.2.1.3 Dimensions of steel section and tolerance of dimension shall conform to standard dimension of steel regulated in ASTM or BS standard.

8.2.2 Bolt

8.2.2.1 Shape of bolt, nut, and washer shall be in accordance with requirement of BS 4190 & BS 3692.

8.2.2.2 Quality of bolt shall be SC 43 A.

8.2.3 Welding Rod

8.2.3.1 Arc welding rod shall conform to materials to be welded, and position.

8.3 Fabrication

8.3.1 Main fabrication shall be done in workshop unless otherwise specified or approved by the Consultant.

8.3.2 Full scale drawing of each section shall be drawn prior to fabrication and checked by the Consultant.

8.3.3 Section of each material shall be cut perpendicular to axis unless otherwise specified in the drawing.

8.3.4 Saw and angle cutter shall be used for cutting, and cut section shall be free of any noticeable defect.

8.3.5 Deformation caused by cutting shall be corrected.

8.3.6 Normal temperature or hot drawn process shall do bending process. Steel shall be red heat in hot drawn process.

8.3.7 Those directed in the drawing shall be chiselled finish and completely attached. Materials shall be checked for bend, distortion, warp, etc. before fabrication.

8.4 Bolt

8.4.1 Bolt Hole

8.4.1.1 Spacing of boltholes shall be as directed in the following table.

Diameter of Bolt	Standard Pitch	Minimum Pitch	End Distance	Edge Distance
12	50	30	30	25
16	50	40	40	30

8.4.1.2 Minimum pitch and end distance for lightweight steel shape shall be more than 3 times and 2.5 times a Bolt diameter respectively.

8.4.1.3 Diameter of hole shall not be over 0.5 mm larger than bolt diameter. However, for anchor bolt 5mm clearance shall be allowed between bolt diameter and diameter of hole unless otherwise specified.

8.4.1.4 Bolthole shall either be drilled open or reamed after sub punching. Punching can only be permitted for a material thickness less than 13 mm.

8.4.1.5 Rolled edge around a hole shall be removed.

8.4.1.6 Position of a bolthole shall be precise so that the center of all holes aligns.

8.4.2 Protection against loosing of Nuts

8.4.2.1 Nuts shall be protected against loosing by concrete covering, double nuts or other proper means.

8.5 Welding

8.5.1 Welding

8.5.1.1 Welder shall have an authorized qualification in Maldives and approved by the Consultant.

8.5.1.2 Other tests shall be conducted to confirm welder's skill in accordance with type of work.

8.5.1.3 Tack welding shall be carried out by the welder approved by the Consultant.

8.5.2 Welding Machine

8.5.2.1 Arc welding machine shall be alternate or direct current type, which provides sufficient and adequate current.

8.5.3 Preparation

8.5.3.1 Welding shall be done as much downward as possible using a jig such as Rotary frame.

8.5.3.2 Welding rod shall be always kept in a dry area and if necessary, dried by drying equipment.

8.5.3.3 Welding surface shall be free of water, scale or others injurious to welding work. Slag appeared on the created surface in the middle of welding shall be cleaned before starting again.

8.5.4 Fabrication

8.5.4.1 Welding edge shall be smoothed by automatic gas cutting or other proper finishes.

8.5.8 Finishes

8.5.8.1 Surface of welds shall be as smooth as possible and size and length of welds shall not be less than designed dimensions.

8.5.8.2 Reinforcement of weld shall not exceed 0.1s + 1 mm (s: Designated size) in fillet welds.

8.5.8.3 Welded parts shall be free of undercut, overlap, crack, blow hole, lack of welds, and lack of weld settlement, rolled up slag or other defects.

8.5.8.4 Crater at the end of bead shall be carefully heaped up and slag, sputter, etc. shall be completely removed after welds.

8.5.9 Safety

8.5.9.1 Safe scaffoldings shall be provided for the field welds work.

8.5.9.2 Welding facilities shall be such that there shall be no electric leakage of electric shock. There also shall be sufficient protection for fire.

8.5.9.3 Electric shock protection device shall be used and also care shall be taken not to get suffocated or intoxicated by gas when welding in small area.

8.5.10 Inspection

8.5.10.1 Welding parts shall be inspected before, during and after welding in accordance with work schedule.

8.6 Erection and Field Painting

8.7.1 Erection

8.7.1.1 Erection procedure shall be prepared by the contractor and be approved by the Consultant prior to the erection.

8.7.1.2 Material shall be stored on flat surface in order not to get distortion, twist or other defects. Correction shall be made to those distortions or twisted before erection.

8.7.1.3 Horizontal reinforcement and bracing shall be placed and bolts are temporary tightened as trusses are put up.

8.7.1.4 Connection of materials by bolts, etc. shall be made after distortion on plumb is thoroughly corrected.

8.7.1.5 Temporary bracing or other reinforcement shall be placed to resist wind pressure or other loads erection.

8.7.1.6 When heavy objects are placed on a horizontal element in the course of erection, they shall be reinforced with prior approval of the Consultant.

8.7.1.7 Care shall be taken on all facilities so that there is no accident.

8.7.2 Field Painting

All steel work shall delivered to site unprimed shall be cleaned of impurities, scrapped and wire brushed to remove rust and painted with one coat of priming paint applied by brush.

Steelwork delivered to Site primed shall be cleaned of impurities and damage to the priming paint and made good with priming paint.

Galvanized steelwork to be painted shall be cleaned of impurities. Where rusting has occurred the rust shall be removed by wire brushing and made good with an approved rust inhibitor. The surfaces shall be coated with a mordant solution, washed with clean water and painted with two coats of priming paint applied by brush.

Steelwork, which is to be concealed shall be prepared and primed as above and shall be painted with two priming coats and one finishing coat of paint applied by brush.

8.8 Anchor Bolt

8.8.1 The other methods for movable burying shall be as directed by the Consultant.

9. MASONRY

9.1 Materials

9.1.1 Material used for masonry and plastering work shall conform to Section 3 - CONCRETE WORKS.

9.1.2 Masonry work shall be done with cement bricks or blocks of approved quality unless specified otherwise.

9.1.3 The blocks shall be free from excessive amounts of salt or other impurities and shall be inspected and approved by the Consultant.

9.2 General

9.2.1 Execution Drawing

9.2.1.1 Work shall be complied with this specification unless otherwise stated on particular Specification or Drawings. Any work not specified shall be discussed and directed by the Consultant. Execution drawing of block or brick alignment (inclusive of indication for hanging bolt, wood plug and conduit pipe), detail reinforcement, window opening, and other requirement shall be prepared and submitted for the Consultant.

9.2.2 Stake-Board

9.2.2.1 Stake-board shall be provided at each 5m in length and shall be inspected by the Consultant for the accuracy, firmness and secureness. However, suitable ruler, plumb bob and leveller shall be provided for minor performance of cement block and bricks.

9.2.3 Transportation and storing

9.2.3.1 Care shall be taken for damage during transportation of materials and any defect of natural finished concrete blocks or bricks shall be rejected.

9.2.3.2 Different size of material shall be stored separately and projected from dirt and other impurities.

9.2.4 Curing

9.2.4.1 Any shock or load shall not be applied until concrete mortar or other fills hardened. Corner, projection and top of cement block or brick work shall be protected from rain, dryness, cold, damage and stain by covering.

9.2.4.2 Void between blocks or bricks shall not be intruded by rainwater.

9.3 Blockwork

9.3.1 Material

9.3.1.1 Blocks shall be of standard quality low permeability blocks with no defects and sample shall be submitted for approval of the Consultant.

Blocks shall be **Solid cement blocks 125 mm thick for external walls and hollow cement blocks 100 mm thick for internal walls.** The average compression strength should be not less than 2.8N/mm^2 and shall comply with physical requirements of ISO 6073: 1981

9.3.2 Horizontal reinforcement for concrete block wall;

9.3.2.1 Horizontal reinforcement shall be provided at end of wall adjoining to concrete column. Reinforcing bar shall be anchored into end block and column.

9.3.2.2 Horizontal reinforcing bar for block wall shall be 6 dia. @ 1000 mm.

9.3.3 Placing Blocks & Bricks

9.3.3.1 Cement blocks shall be saturated with water and joint shall be cleaned.

9.3.3.2 Bonding mortar shall be used immediately after mix, and mixed mortar left for more than one hour shall be rejected.

9.3.3.3 Vertical and horizontal joint of blocks shall be filled completely and suitable with mortar on line shall not be moved or rearranged. Joint and surface of block of exposed finished block wall shall be cleaned immediately after joint is filled.

9.3.3.4 In case concrete block wall is attached to structural concrete, block wall shall be placed before concreting structure.

9.3.3.5 Mortar for joint shall be touched with steel trowel before hardened and exposed joint shall be finished with uniform width and planned without roughness or cavity.

9.3.3.6 Height for placing block per day shall be maximum 1.2 m unless otherwise specified.

9.3.3.7 Blocks shall be placed with cavity side under.

9.3.4 Joints

9.3.4.1 The thickness of joints shall not exceed 10 mm and the joints shall be rated (13 mm dup.) when the mortar is still floor, so as to provide for proper bond for the plaster. Any mortar which falls on the floor from this joints or removed due to raking of joints shall not be reused.

9.3.5 Lintel

9.3.5.1 Lintel shall be reinforced concrete as approved or directed by the Consultant.

9.3.5.2 Main reinforcing bar shall be anchored more than 40D (40 x diameter of the bar) at both end.

9.3.5.3 In case lintel is prefabricated, shop drawing shall be submitted for approval of the Consultant.

9.3.6 Frame of Opening

9.3.6.1 In case frame is temporarily installed before placing of blocks, frame shall be firmly placed and joiner shall be bonded with mortar as placing each block at side and top of frame.

9.3.6.2 In case frame is installed after placing of blocks, joiner shall be bonded with additional mortar at space or every two blocks or more.

9.3.6.3 Back of frame shall be filled and compacted with mortar by providing shuttering board.

9.3.6.4 Wood plug and anchor bolt shall be covered with mortar or concrete.

9.3.7 Piping

9.3.7.1 Principally, piping shall not be placed in block wall unless piping block is in use.

9.3.7.2 In case electric conduit pipe is placed in cavity of concrete blocks, care shall be taken not to obstruct reinforcing bar, and cavity shall be completely filled.

9.3.7.3 In case chipping and piping on face of blocks is unavoidable, performance shall confirm to instruction of the Consultant.

9.3.7.4 Joiner and supporter for exposed piping shall be buried at joint which back is filled or otherwise approved by the Consultant.

10. PLASTERING

10.1 General

10.1.1 All masonry walls shall have smooth finished cement plaster on both sides with a surface setting coat of neat cement applied within an hour of the completion of rendering.

10.1.2 Cement rendering to floor shall be same as above.

10.2 Materials and Storage

10.2.1 Plaster materials which are affected by moisture such as plaster and cement shall be stored properly.

10.2.2 Materials used for plastering shall conform to those of Section 3 - Concrete Works. Grading of sand, however, shall be as in table below

Grading of sand	Mortar plastering	Plastering
5mm sifting thorough 100% 0.15mm sifting less than 10%	for first coat for finish coat	for first coat and dubbing out
2.5mm sifting through 100% 0.15mm sifting less than 10%	for finish coat	for second coat

10.2.3 White cement or filler or similar shall confirm to the requirements of Portland cement, BS.12.

10.2.4 The use of mixtures shall be approved by the Consultant's representative. The amount of admixture shall be such that it affects mortar strength very little.

10.3 Mixing ratio

10.3.1 Mixing volume ratio of mortar shall be as in table below:

Base	area of application	first coat cement:sand	Dabbing out cement:sand	Finish coat cement:sand
Masonry blocks	Floor	-	-	1:4
	Interior wall	1:4	1:4	1:4
	Exterior wall	1:4	1:4	1:4

10.4 Thickness of Coating

Standard thickness of coating (mm)

Base	Area of application	First coat	Dubbing out	Second coat	Finish coat	Total
Masonry block	Floor	-	-	-	as per dwg	as per dwg
	Interior wall	8	-	8	4	15
	Exterior wall	8	-	8	4	15

Thickness of coating shall be standard thickness of coating unless otherwise indicated on the Drawings.

10.5 Finish

10.5.1 Type of finish and work schedule

Type	Work Schedule	Notes
1. Smooth Trowel finish	1. Shall be applied flat by metal trowel 2. Shall be finished by pressing with the trowel.	Before applying second coat, corner and edge shall be screed well.
2. Wooden float finish	Shall be applied by wooden float	

10.6 General Preparation

10.6.1 Remove efflorescence, laitance, dirt and other loose material by thoroughly dry brushing.

10.6.2 Remove all traces of paint, grease, dirt and other materials incompatible with coating by scrubbing with water containing detergent and washing off with plenty applying coatings unless specified otherwise.

10.6.3 In-situ Concrete Surfaces: Scrub with water containing detergents to ensure complete removal of mould oil, surface retarders and other materials in compatible with coating . Rinse with clean water and allow to dry unless specified otherwise.

10.6.4 Organic Growths: Treat with fungicide to manufacturer's recommendations and bush off.

10.6.5 Hacking for Key: roughen specified surfaces thoroughly and evenly by removing the entire surface to a depth of 3mm by scabbling, bush hammering or abrasive blasting, clean surfaces by washing and brushing.

10.6.6 Smooth Concrete Surfaces: where no keying or mix or bonding agent is specified, wet smooth concrete surfaces immediately before plastering.

10.7 External Plastering

10.7.1 Dissimilar Solid Backgrounds for Plastering: where plaster is to be continued without break across joints between dissimilar solid backgrounds which are rigidly bonded together, cover the joints with a 200mm wide mesh strip (back grounds in the same plane) or with the corner mesh (internal angle) fixed at not more than 600mm centers along both edges , unless specified or otherwise.

10.7.2 Dissimilar Solid Backgrounds for Plaster: where plaster is to be continued without break and without change of plane across the face of a 300mm and rigidly bonded to the background.

10.7.2.1 Cover the face of the column /beam/ lintel with building paper extending 25 mm on the adjacent background.

10.7.2.2 Over lay with expanded metal lathing extending 50mm beyond the edges of the paper and securely fixed with masonry nails at not less than 100mm centres along both edges.

Alternatively, an approved paper and mesh lathing may be used.

10.7.3 Dissimilar Solid Backgrounds for Rendering: where rendering is to be continued without break across joints between dissimilar solid backgrounds which are in the same plan and rigidly bounded together, cover joints with a 150mm wide strip of building paper overlaid with 300mm wide metal lathing fixed at not more than 600mm centers along both edges unless specified otherwise.

10.7.4 Service Chases: cover with steel mesh strip fixed at not more than 600mm centers along both edges.

10.7.5 Conduits bedded in under coat to be covered with 90mm wide jute scrim budded in finishing coat mix, pressed flat and trowelled in. Do not lap ends of scrim.

10.8 Internal Plastering

10.8.1 Accuracy of plaster 15mm thick or more: maximum permissible gap between an 1800mm straight edge and any point on the surface to be 3mm.

10.8.2 Dubbing Out: if necessary to correct inaccuracies, dub out in thickness of not more than 10mm in same mix as first coat. Allow each coat to set before the first is applied . Cross scratch surface of each dubbing out coat immediately after set.

10.8.3 Metal Mesh Lathing: Work undercoat well in to interstices to obtain maximum key.

10.8.4 Under Coats: generally to be not less than 8mm with thickness greater than 16mm applied as two equal coats. Rule to an even surface and cross scratch - end coat to provide a key for the next hand applied coat.

10.8.5 Cement Based Under Coats: all to dry out thoroughly but not rapidly, to ensure that drying shrinkage is substantially complete before applying next coat.

10.8.6 Dissimilar Backgrounds: where scrim or lathing or beads are not specified, cut through plaster with a fine blade in a neat, straight line at junctions of :

10.8.6.1 Plastered rigid sheet and plastered solid backgrounds.

10.8.6.2 Dissimilar solid backgrounds.

10.8.7 Smooth Finish: trowel or float to product a tight matt, smooth surface with no hollows abrupt change of level or trowel marks. Do not use water brush and avoid excessive trowelling and over polishing.

10.9 External Rendering

10.9.1 Dubbing Out: if necessary to correct inaccuracies, dub out in thicknesses of not more than 10mm in same mix as first coat. Allow each coat to dry before the next is applied. Cross scratch surface of each dubbing out coat immediately after set.

10.9.2 Under Coats for hand applied finishes:

10.9.2.1 Apply first undercoat or dubbing out coat by throwing from a trowel.

10.9.2.2 Coats to be no less than 8mm thick, with thickness greater than 16mm applied as two equal coats. On weak backgrounds first under coat to be not less than 10mm thick.

10.9.2.3 Brush down each under coat to remove dust and loose particles and wet thoroughly before application of next coat.

10.9.2.4 Cross scratch under coat without penetrating the coat, to provide key for following coat(s).

Drying: Keep each coat damp for the first three days by covering with polythene sheet and/or spraying with water. Thereafter prevent from drying out too rapidly. Work in shade whenever possible.

Allow each coat to dry out thoroughly to ensure that drying shrinkage is substantially complete before applying next coat.

Playing Floated Finish: Finish with wood or other suitably faced float to give an even texture.

Do not draw excessive laitance to surfaces.

10.10 Metal Mesh Lathing / Reinforcement For Plastered/Coatings.

10.10.1 Lathing to be provided as reinforcement for plastering in columns, walls or specified in drawings products.

10.10.2 Products:

10.10.2.1 Plain Expanded Metal Lathing: To B.S 1369 with a minimum weight of 1.9 kg/mm^2. Manufacturer to approval of the Consultant.

10.10.2.2 Wire Ties: Unless other specified, annealed iron, galvanized to B.S 443.

10.10.2.3 Clout Nails: galvanized steel or stainless steel nails to B.S 1202: Part 1, table 3.

10.10.2.4 Staples: Galvanized steel wire staples to B.S 1494: Part 2.

10.10.3 Workmanship

10.10.3.1 Framing: fix securely and accurately to help ensure that coatings on lathing , when finished, are true to line and level , within specified tolerances and free from cracks, rippling, hollows, ridges and sudden changes of levels.

10.10.3.2 Runners/Bearers spanning between concrete beams/ribs: fix with 3mm wire ties twisted around 38 mm X 10 gauge screws driven well into fixing blocks or plugs in sides of beams/ribs.

10.10.3.3 Wire Ties: twisted ends tightly together, cut off surplus and bend ends of wire away from face of coating.

10.10.3.4 Plain Expanded Metal Lathing:

(a) Stretch lathing and fix securely in accordance with manufacturers recommendations to give a taut, firm base for plaster/ rendering.

(b) Fix with the long way of the mesh at right angles to supports and with all strands sloping in the same direction.

(b) Lap side edges not less than 25mm. Lap ends 50mm at supports and 75mm between supports. Laps must not occur within 100mm of angles or bends.

11. CARPENTRY AND JOINERY

11.1 Materials

11.1.1 Timber shall be in accordance with the requirements of BS 1186 'Quantity of Timber and Workmanship in Joinery', Part 1, 'Quality of Timber'.

11.1.2 Timber and timber products shall be subject to the inspection and approval of the Consultant.

11.1.3 Timber shall be seasoned to stable moisture content compatible with the finished use, straight and true and free from wind, warp and distortion and in lengths suitable for the members required.

11.1.4 All timber shall be in long lengths and laps, scars or splices shall be over a bearing surface. Where obtainable, finishing timber exposed to view shall be in single lengths.

11.2 Preservation of Timber

11.2.1 All timber shall be treated for insect attack and is to be of the correct moisture content and free from surface moisture content and dirt.

11.2.2 All rafters, purlins, framing scribe pieces, wall plates, and trusses etc. shall be treated for insect attack with approved timber preservative. No extra payment shall be made for such coating and will be considered inclusive in the rate of the respective item in the BOQ.

11.2.3 Treatment shall be carried out after all cutting and shaping is completed.

11.3 Hardware

11.3.1 Hardware shall be standard quality and samples shall be submitted to the Consultant for approval.

11.3.2 All hinges shall be stainless steel or brass and shall be approved by the Consultant.

11.3.3 The dimensions and quality of hardware shall meet the requirements and shall not be rested, deformed or defective.

11.4 Dimensions and Finish

11.4.1 All dimensions of timber given are finished dimensions.

11.4.2 All elements and others of structural nature, which are exposed, must be machine planed to a smooth finish.

11.4.3 All unexposed timber shall be machine planed to a rough finish.

11.4.4 All joinery work shall be dressed on all four sides and hand dressed where necessary and sanded to all exposed surfaces. All arises in any way accessible shall be sanded and smoothed off.

11.5 Workmanship

11.5.1 All connections whether nailed, screwed glued, mortised or dove-tailed shall be accurately made and properly executed to provide sound, satisfactory connections for the class of work required.

11.5.2 Timbers containing defects or distortions shall not be used.

11.5.3 All joinery shall be manufactured by skilled tradesman with accurate tolerances and set out and with tools, jigs, machines and equipment appropriate for the work.

11.5.4 Assembly of the joinery units and joinery frames, etc. shall be by means of glued connections appropriate to the work - mortise and tennon, housing and doweling, etc. where practicable including the use of glued blocks wherever required. Nailing, screwing shall only be used with prior approval of the Consultant; corrugated fasteners shall not be used for effecting connections.

12. ALUMINIUM DOORS AND WINDOWS

12.1 Aluminium Doors and Windows

12.1.1 All windows and doors are to be constructed by approved specialist suppliers of medium section to the particular requirements noted on the drawings as to weight and profile. All sections shall generally conform to relevant British Standard Specifications.

12.1.2 All frames should be made to fit the actual openings with a 3 mm clearance all around. Discrepancies in overall width or height exceeding 3mm will not be allowed and the frames will be rejected in such cases. Any small discrepancies shall have the gaps suitably backed and filled with gun-applied water repellent mastic sealant

12.1.3 All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245. All spliced joints between mullions should be sealed with an approved silicone product, compatible with other sealants and packings used.

12.1.4 The auxiliary components in sashes as locks, pivots, sliding gear etc. shall comprise of stainless steel or resisting materials.

12.1.5 The tolerances are to be as follows:

a) Inside width of frame 3mm Maximum
b) Inside height of frame 3mm Maximum
c) Depth of frame 2mm Maximum
d) Opposite side, Inside distance 2mm Maximum

12.1.6 The performance-associated requirements are

1) Strength (resistance to wind pressure and other forces applied in use)
2) Airtightness or ability to cut out drafts.
3) Watertightness against rain or dew.
4) Sound-arresting effect to (shut off noise from outside as well as inside).

12.1.7 All surfaces shall have an anodized protective surface layer of a minimum 60 Micron thickness.

12.1.8 Glazing shall be done as specified by the Consultant. Glass shall be reflective in exterior, or as specified in the drawings. Thickness shall be according to the size of panels as given here under.

Not exceeding 1 sq. ft.	6mm
Exceeding 1 sq. ft. but not exceeding 2 sq. ft.	7mm
Exceeding 2 sq. ft. but not exceeding 4 sq. ft.	8mm
Exceeding 4 sq. ft. but not exceeding 6 sq. ft.	9mm
Exceeding 6 sq. ft. but not exceeding 12sq. ft.	10mm
Exceeding 12sq. ft.	> 12mm or as approved by

12.1.9 Before import and/or purchase of the Aluminium Doors and Windows, the relevant specification of the manufacturer, along with samples and shop drawings, has to be submitted to the Consultant for approval. This clause shall not be contravened on any account.

12.1.10 The fitting shall be done with utmost care not to spoil the finishes given by the manufacturers, and any cleaning done shall be done with cleaners etc. as specified by the manufacturers.

11.1.11 The Contractor shall provide all items, articles, materials, operations mentioned or scheduled on the drawings, including all the labour, materials, including fixing devices, equipment and incidentals necessary as required for their completion.

12.1.12 The Contractor shall submit shop drawings and/or samples of each type of doors, windows, railings and other items of metal work to the Consultant for approval. The shop drawings shall show full-size sections of doors and windows, etc. thickness of metal, details of construction hardware, as well as connection of windows, doors, and other metal work to adjacent work.

All **metal works** shall conform to the following **minimum thickness** requirements unless otherwise specified in the approved drawings or technical specifications:

- Non-structural metal elements (e.g., window frames, door frames, railings not bearing load, trims, covers, etc.) shall have a minimum thickness of 2.0 mm.
- Structural metal elements (e.g., handrail posts, load-bearing frames, brackets, and supports) shall have a minimum thickness of 2.5 mm.

All metal works shall be fabricated, finished, and installed in accordance with relevant provisions of the **British Standards (BS)**, including but not limited to:

- **BS EN 1993** – *Eurocode 3: Design of Steel Structures*
- **BS 476** – *Fire tests on building materials and structures* (if applicable)
- **BS 6180** – *Barriers in and about buildings – Code of practice* (for balustrades and railings)
- **BS 4873** – *Aluminium alloy windows – Specification*
- **BS 644** – *Timber windows and doorsets – Specification* (for comparison in mixed material frames)

The contractor shall ensure that all fabrications are **corrosion-resistant**, and protective coatings shall comply with the relevant **BS EN ISO 12944** for paint systems and **BS EN ISO 1461** for hot-dip galvanizing where applicable.

12.1.13 Aluminium doors and shutters shall be manufactured by an approved manufacturer and shall be of sections, sizes combination and details shown on the drawings. The frame member shall be one piece, corners shall be electrically welded, ground smooth and true and glazing bare shall be threaded or interlocked as approved by the Consultant.

12.1.14 Glazing for doors and windows shall be of specified thickness and of approved quality and shall conform to specification of glazing. Fixing for glazing shall be done with aluminium Snap-On beading as per detail drawing and instructions. Necessary continuous rubber gaskets of approved make shall be provided.

12.1.15 Colour for doors and windows shall be approved by the Consultant.

12.2 Aluminium louvers

12.2.1 Product data shall be submitted for approval; this shall include specified model and AMCA ratings or equivalent.

12.2.2 Contractor shall submit all shop drawings indicating materials, construction, dimensions, accessories, and installation details.

12.2.3 Contractor shall submit samples of the product for approval.

12.2.5 Louvers shall comply with AAMA specification 2605 “Voluntary Specification for High Performance Organic Coatings on Architectural extrusions and panels”, ASTM B244 -68, AAC22A41 or equivalent.

12.2.6 Louvers shall be well suited for the design environment (temperature, humidity, and ventilation); i.e., it shall be within manufacturer’s recommended design environment limits for optimum results.

12.2.7 All louvers shall be installed according to manufacturer’s instructions.

12.2.8 All units shall be installed plumb, well fitted and securely attached to supporting frames.

12.2.9 Delivery of materials to site in shall be in manufacturers’ original, unopened containers and packaging with labels clearly indicating manufacturer, material and location of installation.

12.2.10 Materials shall be stored in a dry area indoors and protected from damage in accordance with manufacturer's specifications.

12.2.11 Materials and finishes shall be protected during handling & installation to prevent damage.

12.3 Top hung windows, ventilators and side hung doors

12.3.1 All windows and doors should be weather stripped. The weather protection should be achieved by a positive compressive action against the section and should not depend on external contact. At every contact between two profiles, two weather-stripping sections should be provided to complete weather protection.

12.3.2 The bottom section for hinges must be capable of being adjusted vertically if necessary. The gap between the section and the floor should be covered with a pair of special splay-tube sections.

12.3.3 The shutter sections for both windows as well as doors shall be hollow section type and shall be overall size 57 x 45 mm, and the door sections shall be overall size 81 x 45 mm (including flanges).

12.3.4 The shutters of the windows and doors should be assembled with stainless steel pins and nylon washers. Handles shall be anodized aluminium finished to match the aluminium sections and mounted with self-lubricating nylon washers.

12.3.5 A mortise cylinder rim automatic deadlock of high quality with double pin tumbler shall be used.

12.3.6 Windows shall have anodized aluminium handles, colour as framing, and a latching mechanism securing the shutter to the frame both at the top and bottom.

12.3.7 Required fittings;

12.3.7.1 Single action door closer concealed in the head bar of the outer frame and mounted on an adjacent pivot at the threshold and deadlock fitted.

12.3.7.2 The left-hand leaf of double doors with flush bolts at head and sill with deadlock fitted to the right-hand leaf.

12.3.7.3 Escape doors to have panic bolt assembly with vertical elements concealed in the sill and door closer as in 12.3.7.1.

12.4 Installation

12.4.1 Aluminium work shall be installed adjusted and glazed by experienced workmen all in accordance with the manufacturer's installation instructions and in full conformity with the approved shop drawings, samples and other submitted data. Under no circumstances shall materials be installed on surfaces that contain condensation, dirt, grease or other foreign encountered materials that would hinder or prevent proper installation and functioning for the use intended.

12.4.2 Aluminium work shall be carefully and accurately assembled with proper and approved provision for contraction and expansion and set in correct locations as per approved detailed shop drawings, all level, square, plumb and aligned with other work. All joints between framing and structural building shall be sealed in order to be watertight and weather-proof and to satisfy all other requirements of the Consultant.

12.4.3 Frames shall be designed and manufactured with a maximum 2.5mm tolerance around the opening in the structure. These joints are to be finished by applying an approved sealant into a polystyrene foam backing strip.

12.4.4 All aluminium works are to be fully protected for the duration of the contract from damage by other trades. The Consultant shall approve the method of protection.

12.4.5 If for any reason final finishes become scratched, abraded or damaged during transport, delivery, storage or erection, it shall be the Contractor's responsibility to remove or repair those defective areas or components as directed and to the complete satisfaction of the Consultant.

12.4.6 Repair work shall be identical to the manufacturer's applied finish with regard to gloss, finish and visual appearance. Field touch up of painted aluminium is permitted only with the written permission of the Consultant. Where touch up is not an authorised means of repair the damaged materials must be replaced by new.

12.4.7 Upon completion of work all protective coverings from all exposed surfaces shall be removed. All surfaces shall be cleaned using soap or detergents as recommended by the aluminium manufacturers to remove sealants, discolouration and any other foreign material. Defection of any type determined by the Consultant shall be repaired at the Contractor's expense.

12.4.8 Extreme care shall be taken when cleaning the exterior portion to protect all other adjacent works.

12.5 Sealing joints

12.5.1 The Contractor shall ensure that joints are dry and remove all loose material, dust and grease.

12.5.2 Joints shall be prepared in accordance with sealant manufacturer's recommendations using recommended solvents and primers where necessary.

12.5.3 Adjoining surfaces which would be impossible to clean if smeared with sealant shall be masked.

12.5.4 Backing strips shall be inserted in all joints to be pointed with sealant. When using backing strips, the Contractor shall not leave gaps and shall not reduce depth of joint for sealant to less than the minimum recommended by the manufacturer.

12.5.5 Cavities shall be filled and jointed with sealant in accordance with the manufacturer's recommendations. Sealant shall be tooled to form a smooth flat bead.

12.5.6 Excess sealant shall be removed from adjoining surfaces using cleaning materials recommended by the sealant manufacturer, and shall be left clean.

12.6 Glass installation

12.6.1 Workmanship shall generally be in accordance with CP 152 and respective British Standards.

12.6.2 The glass is to be delivered to the site with adequate protection to prevent damage and where possible it is to be fixed in position immediately after delivery. When fixed the Contractor is to take all necessary precautions to prevent damage during succeeding building operations and will be entirely responsible for the replacement of any broken or damaged glass at his own cost.

12.6.3 The Contractor is to be solely responsible for determining the exact sizes of glass required, including a tolerance of 2mm to each edge and he is recommended to check the necessary dimensions on site.

12.6.4 No glazing is to be carried out until rebates have been painted with primer. Glazing beads as applicable are also to be primed before fixing.

12.6.5 All mastic is to be neatly struck off to agree exactly with site lines inside and out.

12.6.6 Rates are to include for all necessary springs, clips, setting blocks, location blocks and distance pieces and for taking off and later re-fixing loose beads

12.6.7 Glass apertures in timber doors are to be bedded in chamois leather glazing strip, black ribbon velvet or P.V.C. glazing strip to the approval of the Consultant.

13. METAL WALL PANELS

13.1 References

13.1.1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

A. ASTM International:

1. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives.
2. ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics.
3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E108 (Modified) Standard Test Methods for Fire Tests of Roof Coverings.
5. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
6. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
7. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
8. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference.

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. International Organization for Standardization (ISO):

1. ISO 9001-2000 Quality Management Systems - Requirements.

D. National Fire Protection Association (NFPA)

1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

13.2 System Description

13.2.1 Performance Requirements: Provide composite metal panels that have been manufactured, fabricated, and installed to withstand loads from deflection and thermal movement and to maintain performance criteria stated by the manufacturer without defects, damage or failure.

A. Water and Air Leakage: Provide systems that have been tested and certified to conform to the following criteria:

1. Air Leakage, ASTM E283: Not more than 0.06 cfm per ft2 of wall area (0.003 L/s m2) when tested at 1.57 psf (0.075 kPa).

2. Water Penetration: No water infiltration under static pressure when tested in accordance with ASTM E331 at a differential of 10% of inward-acting design load, 6.24 psf (0.299 kPa) minimum, after 15 minutes.

a. Water penetration is defined as the appearance of uncontrolled water in the wall.

b. Wall design shall feature provisions to drain to the exterior face of the wall any leakage of water at joints and any condensation that may occur within the construction.

B. Fire Performance: Provide composite fire rated panels that have been evaluated and are in compliance with regulatory code agency requirements specified herein.

13.3 Submittals

13.3.1 General: Submit listed submittals in accordance with Conditions of the Contract.
13.3.2 Product Data: Submit product data, including manufacturer's SPEC-DATA sheet, for specified products.

A. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.

1. Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets, and location and configuration of joints necessary to accommodate thermal movement.

B. Samples: Submit selection and verification samples for finishes, colors and textures.

1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for composite metal panels with factory applied finishes.

2. Verification Samples:

2.1. Structural: 12 inch × 12 inch (305 × 305 mm) sample composite panels in thickness specified from an available stock color, including clips, anchors, supports, fasteners, closures and other panel accessories, for assembly approval. Include panel assembly samples not less than 24 inches × 24 inches (610 × 610 mm) showing 4-way joint.

2.2. Include separate sets of drawdown samples on aluminum substrate, not less than 3 inches × 5 inches (76 × 127 mm), of each color and finish selected for color approval. Larger samples of standard colors are available with production-applied coatings.

C. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties, or a third-party listing documenting compliance to a comparable code section.

2. Certificates: Product certificates signed by the manufacturer certifying materials comply with specified performance characteristics and physical requirements.

3. Manufacturer's Instructions: Manufacturer's installation instructions.

4. Manufacturer's Field Reports: Manufacturer's field reports.

D. Closeout Submittals: Submit the following:

1. Warranty: Warranty documents specified.

13.4 Quality Assurance

13.4.1 Qualifications:

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
   a. Certificate: When requested, submit a certificate indicating qualification.
2. Manufacturer Qualifications: Company with a minimum of 5 years of continuous experience manufacturing panel material of the type specified:
   a. Able to provide specified warranty on finish.
   b. Able to provide a list of 5 other projects of similar size, including approximate date of installation and name of Architect for each.
   c. Able to produce the composite material without outsourcing of the coating or laminating process.
   d. Able to provide a certificate of registration to ISO 9001-2000.

3. Fabricator Qualifications: Company with at least 3 years of experience on similar sized metal panel projects and qualified by panel material manufacturer. Capable of providing field service representation during construction

13.4.2 Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color (drawdown samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, Mock-Up Requirements Section.

1. Mock-Up Size: to be proposed by contractor
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

13.4.3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 01 Project Management and Coordination, Project Meetings Section.

13.5 Delivery, Storage & Handling

13.5.1 General: Comply with Division 01 Product Requirements Sections.

13.5.2 Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

13.5.3 Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Protection: Protect finish of panels by applying heavy-duty removable plastic film during production.
2. Delivery: Package composite wall panels for protection against transportation damage. Provide markings to identify components consistently with drawings.
3. Handling: Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

13.5.4 Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

1. Storage: Store panels in well-ventilated space out of direct sunlight.
   a. Protect panels from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   b. Slope panels to ensure positive drainage of any accumulated water.
   c. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
2. Damage: Avoid contact with any other materials that might cause staining, denting or other surface damage.

13.6 Project Conditions

13.6.1 Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

13.7 Warranty

13.7.1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

13.7.2 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1. Warranty Period:
    a. Panel Integrity: 10 years commencing on Date of Substantial Completion.
    b. Finish: 10 years commencing on Date of Substantial Completion.

PRODUCTS

13.8 Composite fire-resistive metal panels

13.8.1 Manufacturer: Mitsubishi Plastics Composites America, Inc.

13.9 Product Substitutions

13.9.1 Substitutions: No substitutions permitted.

13.10 Composite Metal Panel Materials

13.10.1 ALPOLIC/fr Composite Fire Resistive Metal Panels:

1. Panel Thickness: 4 mm.
2. Core: Thermoplastic core material with inorganic fillers that meets performance characteristics specified when fabricated into composite assembly.
3. Face Sheets: Aluminum alloy 3105 H14 and as follows:
    a. Coil coated with a fluoropolymer paint finish that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.
    b. Spray coated with specified finish (quantities less than 7500 ft2 (700 m2)).
4. Bond Integrity: Tested for resistance to delamination as follows:
    a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum.
    b. No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).
    c. Thermally bonded to the core material in a continuous process under tension.
5. Fire Performance:
    a. Flamespread, ASTM E84: <25.
    b. Smoke Developed, ASTM E84: <450.
    c. Surface Flammability, Modified ASTM E108: Pass.
    d. Ignition Temperature:
        1) Flash, ASTM D1929: 716 degrees F (380 degrees C).
        2) Ignition: 752 degrees F (400 degrees C).
    e. Flammability, Exterior, Non-load-bearing wall assemblies and panels, NFPA 285: Pass.
6. Product Transparency:
    a. Provide a Product Transparency Declaration (PTD) for the Composite metal panels

13.10.2 Production Tolerances:

1. Width: +/- 2.0 mm.
2. Length: +/- 4.0 mm.

3. Thickness (4 mm Panel): +/- 0.008 inch (0.2 mm).
4. Thickness (6 mm Panel): +/- 0.012 inch (0.3 mm).
5. Bow: Maximum 0.5% length or width.
6. Squareness: Maximum 0.2 inch (5.1 mm).
7. Edges of sheets shall be square and trimmed with no displacement of aluminum sheets or protrusion of core material.

13.11 Accessories

13.11.1 General: Provide fabricator's standard accessories, including fasteners, clips, anchorage devices and attachments for specific applications indicated on contract documents.

13.12 Related Materials

13.12.1 General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including coldform metal framing, flashing and trim, joint sealers, aluminum windows, glass and glazing and curtain walls.

13.13 Fabrication

13.13.1 General: Shop fabricate to sizes and joint configurations indicated on drawings.
1. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by the fabricator.
2. Form panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
3. Fabricate with sharply cut edges and no displacement of aluminum sheet or protrusion of core.

13.14 Finishes

13.14.1 Factory Finish: Lumiflon-based fluoropolymer resin coating that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.
1. Color: to be approved by client's requirement

13.15 Source Quality

13.15.1 Source Quality: Obtain composite panel products from a single manufacturer.

EXECUTION

13.16 Manufacturer's Instructions

13.16.1 Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions.

13.17 Examination

13.17.1 Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for product installation.

13.18 Preparation

13.18.1 Surface Preparation: -

13.19 Installation

13.19.1 General:

1. Install panels plumb, level and true in compliance with fabricator's recommendations.
2. Anchor panels securely in place in accordance with fabricator's approved shop drawings.
3. Comply with fabricator's instructions for installation of concealed fasteners and with provisions of Section 07 90 00 for installation of joint sealers.
4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4 mm in 6.1 m), noncumulative.

13.19.2 Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

13.20 Field Quality Requirements

13.20.1 Field Quality Control: Comply with panel system fabricator's recommendations and guidelines for field forming of panels.

13.20.2 Fabricator's Field Services: Upon Owner's request, provide fabricator's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with fabricator's instructions.

1. Site Visits: As requested by owner

13.21 Adjusting

13.21.1 Adjusting:

1. Repair panels with minor damage such that repairs are not discernible at a distance of 10 feet (3 m).
2. Remove and replace panels damaged beyond repair.
3. Remove protective film immediately after installation of joint sealers and immediately prior to completion of composite metal panel work.
4. Remove from project site damaged panels, protective film and other debris attributable to work of this section.

13.22 Cleaning

13.22.1 Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

13.23 Protection

13.23.1 Protection: Protect installed product's finish surfaces from damage during construction.

1. Institute protective measures as required to ensure that installed panels will not be damaged.

14. ROOFING

14.1 Scope

14.1.1 This Section deals with steel profiled sheeting used as external weather-proof cladding of roofs.

14.2 Roof Cladding

14.2.1 Sheet type: Spandek hiten roofing sheets manufactured by John Lysaght, No.18 Benoi Sector, Jurong, Singapore 2262 or equivalent.

14.2.2 Structural support: timber sections as per drawings.

14.2.3 Fastening: No. 12-14x45mm hexagonal head self-drilling and tapping screw seal.

14.2.4 End laps: 200mm and should be sealed with a recommend sealant for pitches below 7 degrees.

14.2.5 Side laps: as per manufacturer's recommendations.

14.3 Products

14.3.1 The profiled sheeting shall be in galvanized sheet steel with a factory per finished protective PVC film with colour to approval.

14.4 Workmanship

14.4.1 Accessories: Flashing, trims, filler pieces, spacers, tapes, sealant, etc. where not specified to be the types recommended by the sheet manufacturer.

14.4.2 Fastening: Select types and location of fastenings to meet the following requirements.

14.4.2.1 Wind suction loaded: Calculate in accordance with CP 3: Chapter5: Part2 , making due allowance for any internal pressure.

- Basic wind speed: 45 m/sec.
- Topography factory S1 : 1.0
- Ground roughness, building size and height Factory (S2) : as determined from CP3:Chapter5 : Part 2, Table 3.
- Statistical factor (S3) : 1.0

14.4.3.2 Imposed loads other than wind and maintenance load, 1.5 KN/m2 concentrated on a 300mm^2 which ever produces the greater stress. Maintenance point load: 0.9 KN concentrated on any 125mm^2.

14.4.3.3 Dead load: allow for self-weight of sheeting.

14.4.3.4 Roof pitch: as indicated on drawings.

14.4.3.5 Distance between not less than 900mm or as indicated on the drawings.

14.5 Fixing

14.5.1 Quality of Work: Handle and store to preserve surface using clean dry gloves. Do not slide sheets over rough surface or each other. Packs of all sheets must be kept dry in transit and stored clear of the ground under cover to prevent water and /or condensation being trapped between adjacent surfaces. If packs become wet, sheets should be separated, wiped with a clean cloth without delay and placed so that air calculation completes the drying process.

14.5.2 Structure: Check that structure is in a suitable state to receive sheets before commencing fixing. Contractor must confirm acceptance to consultant

14.5.3 Structure: Do not fix profiled sheeting until final coats of paints have been applied to outer surfaces of supporting structure.

14.5.4 Isolating Tape: Apply to those surfaces of supports which would otherwise be in contact with sheeting or accessories after fixing.

14.5.5 Cutting and drilling:

14.5.5.1 Cut sheets accurately with clean, true lines and no distortion with a power saw with an abrasive cutting disc.

14.5.5.2 Cut openings in sheet for outlets, vent pipes, flues, etc. to the minimum size necessary. Reinforce edges of openings with structural members.

14.5.5.3 Drill all holes. Position at regular intervals in straight lines. Holes for primary fastenings to be 1.5mm larger than the diameter of fastening unless self-drilling type is used.

14.5.5.4 Remove burrs, drilling swarf, lubricant, dust and any other foreign matter before finally fixing sheets into position.

14.5.6 Direction of Laying: Lay sheets with exposed joints of side lap away from prevailing wind.

14.5.7 End Laps: to be fully supported.

14.5.8 Sealant:

14.5.8.1 Install to manufactures recommendation.

14.5.8.2 Position in straight, unbroken lines parallel to edges of sheets. Placed into corrugations. Do not allow to sag into position.

14.5.8.3 Ensure continuity and effectiveness of seal, especially at corners of sheets.

14.5.8.4 Do not over compress.

14.6 Fittings and Features

14.6.1 Profile Fillers: use where specified and wherever necessary to close off corrugation cavities from the outside and inside of the building. Position on the line of, or above, fastening and ensuring a tight fit and leaving no gaps. Where sealed laps are specified bed profile fillers in sealant on top and bottom surface, but do not obstruct channels for ventilation or condensation drainage.

14.6.2 Flashing Trims: All fittings for flashing / trim shall be as per manufacturers' recommendation and lapped at joints as follows:

13.6.2.1 Vertical and sloping flashing / trims: end lap to be the same as for adjacent sheeting.

13.6.2.2 Horizontal flashing / trims: end laps to be 150mm and sealed.

14.6.3 Gutter: Ensure that gutters are fully supported at each joint and at intermediate position not more than 900mm apart. Fix with spigot ends up the slope and make all the joints fully watertight. Position sheeting to leave a clear width across the gutter of not less than 230mm.

14.6.4 Insulation:

- 75mm thick Rock Wool insulation blanket with aluminium foil backing on both sides laid between purlins at 1000 centres, including wire mesh. Manufacturer and reference - to approval.

15. FINISHES

15.1 General

15.1.1 Glazed Ceramic Tile shall comply with British Standard specification No. 1281 and shall be approved sizes as shown on Drawings and the product of a reputable manufacturers approved by the Consultant.

15.1.2 Unglazed Ceramic Tile shall comply with the requirements of British Standard No.1286 and shall be of approved sizes as shown on the drawings and the product of a reputable manufacturer.

15.2 Manufacturers

15.2.1 All tiles, ceramic or homogenous/full body, for the project shall be manufactured as mentioned on the finishing schedule/detail drawings. The required type of tile shall be used only in the described locations, and the tile type shall not change unless approved by the Consultant.

15.2.2 The following type of tiles shall be used for the described locations as per the finishing schedule/details drawings. All the tiles shall be submitted to the Consultant for approval before use.

15.3 Ceramic and Vitreous Tile Materials

15.3.1 Homogeneous / Vitreous clay Wall Tiles:

15.3.1.1 All tiles for wall installation shall be have cushion edge, impervious, polished or semi-polished porcelain and highly glazed surface. Colours shall be as selected by the Consultant and shall include trimmers, corner pieces, bullnose and all other special shapes indicated or required. All this shall be free from flaws, cracks and crazing.

15.3.2 Floor Homogeneous and Vitreous Tiles

15.3.2.1 All floor tiles should exhibit required texture as indicated or required (polished, semi-polished, no skid or heavy duty) and it should be laid with 3mm groove. Floor tiles shall be specially prepared for floor use but shall have all the qualities of ceramic tiles listed above for wall use.

15.4 Flooring

15.4.1 Vinyl flooring:

15.4.1.1 Marbleised, directional vinyl sheet and tile flooring with extra-strong polyurethane reinforcement with a subtle blend of light through to dark tones. All vinyl flooring, homogeneous or permanently static dissipative pressed, shall be utilized at specified locations as indicated in the drawing. It shall have the required thickness as indicated in the drawing and shall include coving, cover formers, end cap strip on the coving top.

15.4.1.2 The following brands of vinyl flooring shall be used for the described locations as per finishing schedule/details drawings. All types of vinyl flooring shall be submitted to the Consultant for approval prior to use.

15.4.2 Carpeting:

15.4.2.1 Both loop and cut pile plain fiber carpets must meet the requirements of EN 1307 and should be 100% permanent colour polypropylene having a 5mm underlay with imported grippers. It shall include aluminium single side edging and must be soil and stain resistant.

15.4.2.2 The following brands of carpets shall be used for the described locations as per finishing schedule/details drawings. All types of carpets shall be submitted to the Consultant for approval prior to use.

15.4.3 Cement Flooring:

15.4.3.1 Thin section cement render (2-4 mm thick per coat) shall be used as cement rendering over bricks and/or blocks to achieve a modern rendered finish and shall possess high water resistance. Following brands of cement render shall use for described locations as per finishing schedule / details drawings. All types of cement render shall be submitted to Consultant for approval prior to use.

15.4.3.2 Provision of external cement paving of 450mmX450mmX50mm as well as 75mm interlocking paving as indicated in the drawing for external walkways and car port area respectively. Following brands of paving shall use for described locations as per finishing schedule / details drawings and shall be submitted to consultant for approval before use.

15.4.4 Polyurethane Flooring:

14.4.4.1 A complete seamless, liquid polyurethane flooring (PU) system which should be **Sika ComfortFloor** range or approved equivalent. PU flooring is a seamless, resilient resin surface system which is high elastic, comfort underfoot, and exceptionally durable suitable for industrial applications. Application shall be as per manufactures specifications. **Thickness:** Ranges from **6 mm to 9+ mm** shall consist of Primer, Acoustic layer, base coat and top coat subjected to clients approved color code.

Minimum performance properties

- Shore A hardness: ~80
- Tensile strength: ~1.0 N/mm²
- Tensile adhesion: >1.5 N/mm²
- Elongation at break: ~150%
- Tear strength: ~11 N/mm
- Castor chair resistance: No damage after 25,000 cycles
- Residual indentation: 0.06 mm
- Impact resistance: Class I
- Reaction to fire: Cfl-s1
- Sound insulation: 12 dB

- Slip resistance: R10 / R11
- UV colour fastness: Grade 8

15.4.5 Timber sports flooring: Timber sports flooring specifications center around key athletic performance criteria, material dimensions, and compliance with standards like EN 14904 or ASTM F2772

- **Shock Absorption:** Absorbs impact to protect athletes' joints, typically categorized into area-elastic or combi-elastic reduction classes (minimum thresholds around 10% to over 55% force reduction depending on the subfloor system).
- **Ball Bounce:** Ensures a uniform response, requiring a minimum of 90% rebound performance compared to a concrete baseline.
- **Surface Friction:** Maintained within an 80 to 110 slip-resistance range to prevent slips or dangerous traction locks.
- **Vertical Deformation:** Dictates how much the floor deflects under an impact, generally targeted between 1.8 mm and 5.0 mm for wood systems.

Specification Component	Typical Standard / Range	Description
Wear Layer / Thickness	22 mm solid or 3.5 mm engineered	Hardwood surface (Beech, Maple, Ash, or Oak).
Sub-construction	Sprung battens or foam pads	Dual-batten, cradle-and-batten, or EPDM cushioned pads.
Surface Treatment	UV-hardened polyurethane	Factory-applied anti-scratch and low-gloss sports lacquer.
Environmental Control	Moisture barrier + climate control	Polyethylene vapor film beneath the floor; indoor relative humidity managed between 30%-60%.

15.5 Wall papers

Provision of acrylic/vinyl coated wall papers on plastered walls with 100mm high timber skirting. The plastered walls must be kept dry before placing wall papers to ensure proper adherence of wall paper to the wall and also aides for future removal. Following brands of wall papers shall use for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

15.6 Wood veneer Wood veneer shall comply with ISO 9001 (Quality Management) and ISO 14001 (Environment Management) and finish up to ceiling level with 100mm timber skirting. Its natural wood surface shall be protected by a proprietary wear-resistant film or coat. Following brands of wood veneers shall use for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

15.7 Ceiling

15.7.1 Suspended Ceilings:

15.7.1.1 Suspended aluminium ceilings shall be powder coated with a material, preferably epoxy, polyester or epoxy polyester with the approval of consultant.

15.7.1.2 Aluminium concealed clip-in grid ceiling system comprising a "spring T" or 'A spring" that supports the ceiling tiles. It shall be fixed to and below a primary grid, usually a galvanized channel section as indicated and approved by the Consultant.

15.7.1.3 Provision of plain mineral fibre acoustical suspended ceilings with fibres mixed with wet process with a high quality vinyl emulsion paint surface coating.

15.7.1.4 Following brands of ceiling types shall use for described locations as per finishing schedule / details drawings. All finishing materials shall be submitted to Consultant for approval prior to use.

- Technical Metal Industrial Co.L.C.C (United Arab Emirates)
- Hebei Optimum Construction Materials Co., Ltd (China)

15.7.2 Composite Board:

15.7.2.1 Zinc Aluminium Composite board with multi-layer Ti-Zinc treated surface protected by fluorocarboned resin paint FEVE. Following brands of crash rails shall be used for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

15.8 Corner Guards

15.8.1 Surface mounted guards consisting of a continuous retainer with snap-on Acrovyn 4000 cover. Color matched end caps to be provided for both partial and full height applications and shall be approved by Consultant.

15.8.2 Following brands of corner guards shall be used for described locations as per finishing schedule / details drawings and shall be submitted to Consultant for approval prior to use.

15.9 Crash Rails

15.9.1 Crash rails shall be 150mm wide and comprise of fireproof PVC plastic acrylic cover with aluminium alloy inner-support.

15.10 Partition Walls

15.10.1 Provision of Aluminium Composite board partition wall framed with aluminium extrusion, covered by powder coating. The infill panel shall be laminated glass consisting of two layers of normal glass sandwiched with the underlay polyvinyl butyral (PVB) firm. This shall be provided at described locations as per finishing schedule/details drawings with excellent sound & thermal insulation as well as 100% water proof and resistant to stains.

15.10.2 Tempered glass partition walls at described locations as per finishing schedule/details drawings shall be 12mm thick and insulated properly.

15.10.3 All laminated phenolic board partition systems shall be impregnated with melamine resin and decorated on both sides. It must be resistant to damage from impacts or stains, including indelible inks and highly durable.

15.10.4 Following brands of partition walls shall be used for described locations as per finishing schedule/details drawings and shall be submitted to consultant for approval before use.

15.11 Mortar Materials

15.11.1 Standard brand of light gray or white Portland cement as specified in drawings/Finishing schedule/ BOQ, conforming to current British Standard specifications, shall be used.

15.11.2 Sand: shall be clean, sharp, river sand, conforming to British Standard Specifications and graded fine to coarse within the following limits: 100% passing 8 sieve, 90% to 100% passing 16 sieve, 60% to 90% passing 30 sieve, 25% to 55% passing 50 sieve and 0% to 15% passing 100 sieves.

15.11.3 Premixed cementitious tile adhesive containing cement, polymers, quartz minerals and additives, for bonding ceramic tiles, porcelain tiles and mosaics to floors and walls. Material shall be approved by the Engineer.

15.12 Cement Colour

15.12.1 Dry cement colour, chemically inert, non-fading, alkali fast, mineral pigment, as approved, shall be used wherever refinished.

15.13 Waterproofing

15.13.1 Floors of toilet areas, corridors and planter boxes shall be treated with an appropriate water proofing coating, approved by the Consultant

15.14 Installation Requirements

15.14.1 As far as possible, tile lay out work should be in such a way that no tiles less than half size occurs.

15.14.2 Align joints in wall tile vertically and horizontally except where other patterns are shown or specified, Align joints in floor tiles at right angles to each other straight with walls to conform to the patterns selected.

15.14.3 Verify locations of accessories before installing tiles. Work shall be coordinated with plumbing and other trades before starting of tile work.

15.14.4 Installation of ceramic and vitreous tile shall be in accordance with manufacturer's instructions.

15.15 Floor TileInstallation

15.15.1 Concrete surfaces shall be cleaned and surface of concrete shall be wetted prior to placing of setting bed mortar. Tiles shall be immersed in water for minimum of 4 hours before laying.

15.15.2 Ensure all concrete slabs are allowed to cure fully and have a wood float finish. Steel trowel finished concrete surfaces must be mechanically abraded prior to commencement of tiling works.

15.15.3 Ensure all surfaces are sound, dry and free from excessive movement, oil, dust, grease, wax, curing compounds, release agents and any other loose or contaminating materials. All dust, loose and friable material must be completely removed from all surfaces before application of the approved tile adhesive preferably by brush and/or vacuum.

15.15.4 Setting Bed Mortar Mix: Follow as per approved manufacturer's instructions

15.15.5 All tiles shall be properly aligned with straight joints in even widths. Joints width shall be determined by spacers on ceramic tiles. Tamping shall be completed within one (1) hour after placing tile. Adjust work out of line within this period.

15.15.6 Tiles shall be fitted closely around pipes running through walls and floors. Pitch floors to drains.

15.16 Wall Tile Installation

15.16.1 Premixed cementitious tile adhesive containing, cement, polymers, quartz minerals and additives, for bonding ceramic tiles, porcelain tiles and mosaics to floors and walls. Material shall be approved by Engineer

15.16.2 Setting bed of tiles shall be done with cement slurry or special tile Adhesive (approved by Consultant). The thickness of slurry bed shall be 3mm thick minimum for setting tiles and walls.

15.16.3 Installation of tiles shall be in accordance with standards and applicable requirements previously specified for floor tile.

15.16.4 Tiles shall be installed in perfect vertical plumb and as per the pattern and joints if shown on drawings

15.17 Grouting

15.17.1 Grouting shall not commence for at least 24 hours after placing of tiles.

15.17.2 Grout for floor and wall ceramic and vitreous tiles shall be waterproof, neat white Portland cement with dry cement colour added as directed by the Consultant. If white grout is selected, cement shall be white.

15.17.3 Grout mixed to a creamy consistency in accordance with manufacturer's directions shall be used for joint filling. Maximum width of joints shall be 3mm.

15.17.4 Force maximum grout into the joints with trowel. Before grout sets, strike or tool joints to base of cushion and fill all skips and gaps. Do not permit setting bed materials to show through grouted joints.

15.17.5 Cure grout joints by maintaining damp condition for three (3) days by sponging down, or other methods approved by the Consultant. Allow floors to set 48 hours before permitting ordinary foot traffic.

15.18 Defects in Tiles and Tile Laying

15.18.1 The surface of all tiled floors shall be perfectly in level and shall be executed by experienced workers in the field of tile laying.

15.18.2 A sample panel of laid tiles of each type shall be approved by the Consultant before commencement of tile laying.

15.18.3 Mismatches of colour, chipped or damaged tiles installed by the Contractor shall be rejected and shall have to be replaced by the Contractor at his own cost and risk.

15.18.4 Mismatches of colour in tiles installed by the Contractor shall be rejected and shall have to be replaced by the Contractor at his own cost and risk.

15.19 Guarantees

15.19.1 Manufacturer shall provide his standard guarantees for work under this section. However, such guarantees shall be in addition to not in lieu of all other liabilities which manufacturers and Contractor may have by other provisions of the Contract Documents.

16. PAINTING

16.1 Material

16.1.1 All paints shall be approved by the Consultant for colour, quality and type. All painting work shall be carried out in accordance with the paint manufacturer's specifications unless otherwise directed by the Consultant.

16.1.2 All paints and finishes used for the project shall be manufactured by or under license from the following manufacturers or proposed by the contractor with sample and specification for approval before purchase.

16.1.3 Paint shall be ready mixed and all paints, varnishes, enamels, lacquer stains, paste fillers and similar materials shall be delivered to the site in the original containers with the seals unbroken and labels intact. Each container shall give the manufacturer's name, type of paint, colour of paint and instructions for reducing. Thinning shall be done only in accordance with the manufacturer's directions.

16.1.4 Use of product by the same manufacturer shall be a general rule in each stage of work in this Specification.

16.1.5 Colour, luster, colour scheme, finish shall be decided by the Consultant after checking sample paint test.

16.1.6 The painting shall be performed by experienced and competent painter.

16.1.7 Where walls are specified to be painted, all columns arises, groove, rough surfaces, reveals, soffits and returns, etc. shall be included and no extra shall be payable.

16.1.8 For exterior paint Use a high- build 100% acrylic or elastomeric waterproof coating to bridge micro-cracks and allow breathability.

- **Weather Limits:** Avoid painting in high humidity (>85%), direct heavy rain, or extreme temperatures (typically below 50°F/10°C or above 90°F/32°C)
- **Film Thickness:** Maintain consistent wet and dry film thickness (DFT) as recommended by the manufacturer, typically achieving targeted micron profiles for industrial or structural steel
- **Curing:** Allow 4 hours between standard water-based coats, with full chemical curing taking anywhere from 7 to 30 days depending on environmental conditions

16.1.9 Exterior textured paint specifications typically require a high-grade acrylic or water-based binder mixed with aggregate grit to achieve a dry film thickness of 90 µm to over 1mm per coat.

- **Composition:** Pure acrylic or modified acrylic emulsions with mineral aggregates, quartz, or ceramic beads.
- **Dry Film Thickness (DFT):** Generally, ranges from 90µm per coat for fine finishes up to 1.2 mm for heavy stone-granule or trowel applications.
- **Coverage/Spreading Rate:** Varies between 2 to 6 m^2 per litre depending on the porosity of the substrate and the depth of the texture.
- **Drying & Recoat Time:** Surface dry within 1 hour, with full recoat times between 4 to 6 hours and complete curing taking 24 to 48 hours.
- **VOC & Safety:** Water-based, low-VOC, and non-flammable formulations.

16.2 Definition of Terminology

16.2.1 Surface Sealing

Surface to be painted shall be sealed to have uniform suction and prevent lye from oozing out.

16.2.2 Spot Puttying

All cracks and depressions shall be filled flush with putty.

16.2.3 Puttying

All surfaces to be painted shall be puttied uniformly flat surface.

16.2.4 Spot painting

Spot puttied area shall be touched up by paint

16.2.5 Touch-up

Any damaged area after the prime coat has been applied shall be touched up

16.2.6 Drying hour

The drying time of double-coated paint shall be measured at the temperature of 20°C and humidity of 70%.

16.2.7 Amount of paint

The amount shall be standard amount of paint itself not including thinner. It shall increase or decrease depending on shape and surface condition in the process of painting.

16.3 Paint Finish Symbols

OP	Synthetic resin mix paint finish
VP	Solvent-polyvinyl chloride resin paint finish
EP	Polyvinyl acetate resin emulsion paint finish
AEP	Synthetic resin emulsion paint finish
CL	Clear lacquer finish
EXP	Epoxy resin paint finish
Stipple (OP)	Stippled finish (oil mix paint finish)
Stipple (EP)	Stippled finish (polyvinyl acetate resin emulsion paint finish

16.4 Painting in General

16.4.1 Preparation of Paint

17.4.1.1 Mixing: Paint content with pigment shall be thoroughly stirred to make a uniform consistency.

17.4.1.2 Thinning: Portable water shall be used for thinning of emulsion paint and water-soluble paint. Proper thinner, product of the same manufacturer as paint, as a rule, shall be used for other types of painting. Percentage of thinning and viscosity shall be conducted with direction of manufacturer or catalogue as they vary with the method of paint, temperature, type of material to be painted.

17.4.1.3 Allowable period of Use: Paint mixed with more than 2 types shall be used with direction of a manufacturer or catalogue as allowable period of use, mixing ratio and mixing method vary. The paint which has passed allowable period of use shall not be used.

16.4.2 Conditions of Painting

16.4.2.1 Work shall not be executed in the following situations

16.4.2.1.1 When humidity is above 85%

16.4.2.1.2 When raining or it is forecast

16.4.2.1.3 When dusts are present

16.4.2.1.4 When temperature of surface is high under hot weather and bubbles are likely to develop on the painted surface.

16.4.2.2 Conditions of Surface to be painted: Work shall not be executed or proper means shall be taken in the following situations.

16.4.2.2.1 When surface is damp and wet

16.4.2.2.2 When condensation is likely to develop on the surface.

16.4.2.2.3 All nail holes on veneer, board. etc., shall be covered with proper rust-proof paint before the subsequent painting is applied in accordance with this specification.

16.4.3 Performance

Paint shall be evenly and uniformed applied on the surface. Areas of difficult application such as pointed part, internal angle, welded part, etc. shall be thoroughly painted and double coated as necessary to deep uniform coating thickness.

Painting shall be properly done by carefully selecting the painting method by the shape of surface and types of paint.

16.4.4 Protection

17.4.4.1 Dangerous material such as paint, thinner, etc., excluding emulsion paint and water-soluble paint shall be kept in accordance with regulations concerned.

16.5 Procedure of Painting

16.5.1 Exterior - Surface of Mortar, Plaster and Concrete

AEP- Weather shield Exterior paint

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Exterior Wall Sealer	As per manufacture's specifications
3. Texture base	2	texture base putty mechanically sprayed uniformly	As per manufacture's specifications
4. Surface finishing		Flatten with masonry trowel uniformly surfaced	
5. First coating	1	Weather shield paint	As per manufacture's specifications
6. Finish coating	2	Weather shield paint	As per manufacture's specifications

Notes:

Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5

Puttying and sanding process shall allowed to omit depending on the conditions of the surface.

Drying time of putty shall be long enough for sanding to proceed.

Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

16.5.2 Exterior - Iron Products in General

OP - Synthetic resin mix paint

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and surface.	
2. First Coating 24 hours	1	Rust proof oil paint	As per manufacture's specifications
3. Touch-up		Touch-up rustproof oil paint	
4. First Coating	1	Rustproof oil paint	As per manufacture's specifications

5. Second coating	1	Synthetic resin mix paint	As per manufacture's specifications
6. Finish coating	1	Synthetic resin mix paint	As per manufacture's specifications

Note:

Paint for touch-up painting shall be the same as used for first coat in process No. 2

16.5.3 Exterior - Wood

OP - Synthetic resin mix paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Clean and sand to plane surface	
2. Knot treatment	1-2	Lacquer varnish	As per manufacture's specifications
3. First coating	1	First coat paint of oil mix paint	As per manufacture's specifications
4. Second Coating	1	Oil mix paint	As per manufacture's specifications
5. Finish coating	1	Oil mix paint	As per manufacture's specifications

Note:

Puttying and sanding shall be done after process No.2 when there are cracks, etc. on the surface putty shall be oil-putty, but drying time shall vary depending on conditions.

16.5.4 Interior - Mortar, board, etc.

Stipple (EP) - Polyvinyl acetate resin emulsion paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
3. Puttying		Putty for emulsion paint	
4. Grinding		Grind with proper grinding tool	
5. Spot painting		Second coating paint of polyvinyl acetate resin emulsion paint	
6. Second Coating	2	Polyvinyl acetate resin emulsion paint	As per manufacture's specifications
7. Finish Coating	1	Polyvinyl acetate resin emulsion paint for stipple-finish	As per manufacture's specifications

Notes:

Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5

Puttying and sanding process shall allowed to omit depending on the conditions of the surface.

Drying time of putty shall be long enough for sanding to proceed.

Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

16.5.5 Interior - Mortar, plaster, concrete, etc.

VP Solvent - Polyvinyl chloride resin paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
3. Puttying		Putty for polyvinyl chloride resin paint	
4. Grinding		Grind with proper grinding tool	
5. Spot painting		Solvent-polyvinyl chloride resin enamel emulsion paint	
6. Second Coating	1	Solvent-polyvinyl chloride resin enamel emulsion paint	As per manufacture's specifications
7. Finish Coating	2	Solvent-polyvinyl chloride resin enamel emulsion paint	As per manufacture's specifications

Notes:

(a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5
(b) Puttying and sanding process shall allowed to omit depending on the conditions of the surface.
(c) Drying time of putty shall be long enough for sanding to proceed.
(d) Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

16.5.6 Interior - Mortar, plaster, concrete, etc.

EP Polyvinyl acetate resin emulsion paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Dry, clean and free from impurities	
2. Surface sealing	1	Sealer for emulsion paint	As per manufacture's specifications
3. Puttying		Putty for emulsion paint	
4. Grinding		Grind with proper grinding tool	
5. Spot painting		Polyvinyl acetate resin emulsion paint	
6. Second Coating	1	Polyvinyl acetate resin emulsion paint	As per manufacture's specifications
7. Finish Coating	1	Polyvinyl acetate resin emulsion paint	As per manufacture's specifications

Notes:

(a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5
(b) Puttying and sanding process shall allowed to omit depending on the conditions of the surface.
(c) Drying time of putty shall be long enough for sanding to proceed.
(d) Amount of sealer for surface sealing shall be adjusted with direction of the Consultant as it varies with the surface conditions.

16.5.7 Interior - Iron products, steel.

OP - Synthetic resin mix paint

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and surface	
2. First Coating	1	Synthetic resin rust-proof. Red lead-type, lead compound-type	As per manufacture's specifications
3. Touch-up		Touch-up rust proof paint	
4. First Coating	1	Synthetic resin rust-proof paint. Red lead-type, Lead compound-type	As per manufacture's specifications
5. Second Coating	1	Synthetic resin mix paint	As per manufacture's specifications
6. Finish Coating	1	Synthetic resin mix paint	As per manufacture's specifications

Notes:

(a) Paint for touch-up painting shall be the same as used for first coat in process No.2
(b) When oil rust-proof paint is used instead of synthetic resin rust proof, its specification shall conform to No. 5 and No.6.

16.5.8 Floor - Concrete and Mortar

EXP - Epoxy resin paint finish

Coating Process	No. of Coats	Type of Paint	Drying hour
1. Surface treatment		Dry, clean and free from impurities	
2. First coating	1	First coating paint for epoxy	As per manufacture's specifications
3. Finish Coating	2	Epoxy resin paint	As per manufacture's specifications

Notes:

(a) Degree of dryness on the surface to be painted shall be kept under 6% in water content and below PH 9.5.
(b) Amount of paint and number of paint shall be as directed by the Consultant as they vary with the conditions of surface and required thickness of coating.

(c) Painted surface shall be kept out of use for more than 7 days after application of final coat.