

Construction of 3 Storey Addu Court Complex Building

Technical Specification

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1 GENERAL AND PRELIMINARIES

1.1 GENERAL

The Conditions of Contract, Bill of Quantities and the Drawings shall be read in conjunction with the Specifications and matters referred to, shown or described in the former are not necessarily repeated in the latter.

Notwithstanding the subdivision of the Specifications into various headings, every part is to be deemed supplementary to every other part and the various parts are to be read with each other, so far as it may be practicable to do so, or when the context so permits.

1.2 STANDARDS, MATERIALS, GOODS AND WORKMANSHIP

In various places throughout this specification and the Bills of Quantities reference is made to the Standards, Specifications and Bye-Laws issued by the British Standards Institution and other similar organisations. These references shall in every case be deemed to include the latest edition or issue of such Standards, Specifications and By Laws including all revisions, amendments and addenda subsequently issued. Where materials are not specified to be to a particular British Standard and a British Standard exists in respect of such materials, then the materials shall in all respects comply with the relevant and current British Standard. In such cases where British Standards do not exist, the materials used shall be of the best type available and shall generally be to the Engineer's satisfaction.

Materials, goods and workmanship shall be of the best quality of their respective kinds and, as far as applicable, shall comply in every respect with the requirements of the quoted Standards, Codes of Practice and Specifications or any other National Standard approved by the Engineer. Preambles and descriptions of materials, goods and workmanship given in any one section of the Specifications shall apply throughout the whole of these Specifications unless otherwise described. The substitution of materials, goods, workmanship and the like from that specified shall only be permitted with the written approval of the Engineer.

The Contractor shall submit for the approval of the Engineer a list of names and addresses of the manufacturers and trademarks or names of all the various types of materials and goods he proposes to use in the Works. This list shall include reference to the Specifications Clause or Article to which the materials and goods apply.

All materials used in the Works shall be new and of the appropriate quality all to the Engineer's approval.

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 Engineer shall order the removal of any materials, which he has not approved.

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

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 alternatives be rejected by the Engineer.

1.3 APPROVED MANUFACTURERS

Reference to proprietary items or approved manufacturers shall be construed as establishing a standard of quality and not as limiting competition.

The Contractor may offer alternatives to the materials specified provided that such materials meet or exceed the required minimum standards. The final decision on this matter rests with the Engineer.

1.4 SAMPLES

The Contractor shall furnish for approval with reasonable promptness, all samples as directed by the Engineer. The Engineer shall check and approve such samples with reasonable promptness only for conformance with the design concept of the Works and for compliance with the information given in Contract Documents. The work shall be in accordance with the approved samples.

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

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

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

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

1.5 MANUFACTURER'S INSTRUCTIONS

All items or materials shall be delivered to the Site in the manufacturer's original unopened containers with the manufacturer's brand and name clearly marked thereon.

All items or materials shall be assembled, mixed, fixed, applied, or otherwise incorporated in the Works in accordance with the printed instructions of the manufacturer of the items or materials unless specifically instructed otherwise by the Engineer.

1.6 ORDERING MATERIALS

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. Upon receipt of the Engineer'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 the late placing of such orders. Prior to finalising material orders, the Contractor shall advise the Employer and await the Employer's written approval to complete the same.

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

1.7 SCAFFOLDING

The Contractor shall provide, erect, maintain, dismantle, and clear away at completion proper and adequate scaffolding including that required for Sub-Contractor and Suppliers. Putlog holes shall be made good to match the adjacent surface as the scaffolding is dismantled. The Contractor shall be entirely 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 its entire sufficiency for the work.

If in the Engineer's opinion scaffolding is considered dangerous then the Contractor shall rectify the same at his own expense. All work utilising scaffold shall be halted until the scaffold is corrected all to the Engineer's written approval.

1.8 CUTTING AND PATCHING

The Contractor shall be responsible for all cutting and patching and making good required for all trades for all work and his prices will be deemed to include for all such cutting and patching and making good.

1.9 PROTECTION

The Contractor shall cover up and protect the Works from the weather and from damage by his own or other workmen performing subsequent operations. He shall provide all necessary dust sheets, barriers and guard rails and clear away same at completion.

The Contractor shall take all reasonable and proper steps for the protection of all places on or about the Works, which may be dangerous to his workmen or any other persons or to traffic. The Contractor shall provide and maintain warning signs, red warning lamps and barricades as necessary in all such places.

1.10 SITE HOARDING

The Contractor shall provide a site hoarding at the boundary of the Site as required by the Municipality By-Laws and to the entire satisfaction of the Municipality and the Engineer. The Site hoarding shall be maintained during the progress of the Works and shall be dismantled and cleared away upon completion.

The Contractor shall be responsible for ensuring the security of the Site, for protecting same from trespass and providing all necessary watching and lighting in connection therewith.

1.11 WATER FOR THE WORKS

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, adapt and maintain temporary work as necessary and remove and make good at completion.

1.12 ELECTRICITY FOR THE WORKS

The Contractor shall make all necessary arrangements and provide all artificial lighting and power (maintaining 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.

1.13 EXISTING SITE SERVICES

The Contractor shall follow up and obtain all the required information relating to any existing site services, telephone, electrical, water, drainage and the like on the site before commencing excavation or piling. The Contractor shall be responsible for the protection of all existing services within the site and shall make good at his expense any damage to existing services resulting from his carrying out of the Works to the satisfaction of the Engineer and relevant authority. The Contractor shall be responsible for giving notice to the relevant authority where temporary or permanent re-routing or diverting of existing services is found to be necessary and shall complete same at his own expense to the Engineer's and respective Authorities' approval.

Where diversions of services as aforementioned are not required in connection with the permanent Works, the Contractor shall uphold, maintain and keep same in working order in existing locations.

1.14 PRICING GENERALLY

The Contractor shall satisfy himself as to the scope of the Work shown on the drawings and described in these Contract Documents and his price shall be deemed to cover all his obligations under the Contract and all matters and things necessary for the proper construction, completion and maintenance of the Works. The price shall include for all material, labour and plant - whether mechanical or non-mechanical - required for the completion of the Contract in accordance with the Drawings and Specifications, and removing at completion and making good any surfaces disturbed and if not included in any prices inserted in the Preliminaries for the insurances and bonds required; for the costs of preparing a tender; for the work in connection with measurements and the final account; for profit; and for all other establishment charges and on costs of whatever nature. No claim for additional payment will be allowed for any error or misunderstanding by the Contractor in these respects.

The Contractor has to allow in his pricing for all fees required to obtain the building permit.

1.15 SITE OFFICES FOR CONTRACTOR

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 sub-contractors and suppliers. The offices shall be open at all normal working hours to receive instructions, notices and other communications.

The Contractor shall obtain the approval of the Engineer 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 Engineer shall be carried out at the Contractor's expense.

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

1.16 CONTRACTOR'S SITE AREA

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.

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

The Contractor shall satisfy himself as to the means of access to the Site and other relative items affecting same for both himself, his Sub-Contractors and Suppliers.

1.17 SITE PROGRESS MEETINGS

During the course of the Works, Site 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. Minutes of such Site meetings will be recorded, copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein.

Prior to such meetings the Contractor shall give to the Engineer'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 Engineer's Representative.

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

1.18 PROGRESS PHOTOGRAPHS

The Contractor shall supply once a month, at the time of submitting his Valuation, twelve photographs from 36 exposures showing the progress of the Works. The times and position from which the photograph are to be taken shall be directed by the Engineer.

The photographs shall be submitted in three copies unmounted of a size not less than 15 x 10 centimeters with the description of the viewpoint stamped in ink on the back. The negative shall have the date on same and remain the property of the Engineer and no prints from these negatives may be supplied to others unless previously authorised in writing by the Engineer.

1.19 SETTING OUT

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.

The Contractor shall provide the Engineer 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 Engineer shall not in any way relieve the Contractor of his responsibility.

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.

1.20 NOTICE BOARDS

The Contractor shall provide and maintain one notice board for the Site each consisting of a timber framed board size 1.8 m x 2.8 m supported 2.50 m above.

The board shall be lettered in English by skilled signwriter to include:

- ◆ The Project name
- ◆ The Employer's name
- ◆ The Engineer's name and address
- ◆ The Contractor's name and address

A large scale layout shall be prepared and submitted for the Engineer's approval before fabrication. No advertising material other than the above will be permitted. The siting and layout of Sub-Contractors or Manufacturer's sign boards, if allowed, must be submitted for the Engineer's approval.

1.21 DEFECTIVE WORK

Any defective work materials and also deviations from the working details in respect of setting out, correct lines and levels, verticality, sizes, thicknesses of members and/or any other dimensional variation of any kind whatsoever, shall be removed and reconstructed or otherwise rectified without undue delay to the approval of the Engineer and the Contractor shall be responsible for all additional costs incurred.

1.22 ERECTION EQUIPMENT OR OTHER PLANT

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 Engineer for approval before the work is actually commenced. If approved by the Engineer and Architecturally 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.

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

1.23 LOADING IN EXCESS OF DESIGN LOAD

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

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

Engineer, and the Contractor shall be responsible for any resulting additional costs. The Contractor shall be responsible for making good to the satisfaction of the Engineer any damage to the permanent structure which may be caused by such excess loading.

1.24 BUILDING PERMIT

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

1.25 PERMANENT DRAINAGE, WATER AND ELECTRICITY CONNECTIONS

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.

1.26 HANDING OVER

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 payments in connection therewith shall be paid by the Contractor.

EXCAVATION AND EARTHWORKS

- 2.1 Nature of soil
- 2.2 Original levels
- 2.3 Site investigation report
- 2.4 Excavation
- 2.5 Finish of excavation and inspection
- 2.6 Removal of water
- 2.7 Sheeting and shoring
- 2.8 Storage and disposal of excavated material
- 2.9 Filling and backfilling
- 2.10 Disposition of existing utilities
- 2.11 Safety of adjoining existing buildings
- 2.12 Dewatering
- 2.13 Site clearance
- 2.14 Demolitions

2 EXCAVATION AND EARTHWORKS

2.1 NATURE OF SOIL

The Contractor is to visit the Site and ascertain for himself the condition of the surface of the ground and the type of substrata likely to be encountered in the excavation of the proposed development.

2.2 ORIGINAL LEVELS

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

2.3 SITE INVESTIGATION REPORT

A preliminary site investigation report for the purpose of obtaining building permit has been prepared. It is the Contractor's responsibility to interpretate this Report and take whatever further measures he feels necessary to ensure the satisfactory completion of these Works.

2.4 EXCAVATION

The Contractor shall perform all excavation as required for all work under this Contract as indicated on the Drawings.

Excavation shall be carried out in all materials and by whatever means are necessary accurately to the lines and levels shown on the Drawings, or as ordered by the Engineer.

No blasting of any kind will be permitted.

Except where indicated on the drawings to remain undisturbed, the Contractor shall remove all topsoil, plants, roots, vegetation, rubbish, rocks, etc. from areas lying within limits of structures and from areas to receive fill, embankment, surfacing, road construction, concrete or other construction.

Footings and foundations shall rest on firm undisturbed soil free from loose materials.

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 of same.

Slopes and formation surfaces shall be trimmed true to line and the required profiles shall be left well consolidated, neat and smooth.

Any additional excavation occasioned by slips, falls, wash-ins, etc., shall be made good at the Contractor's expense with mass concrete or approved filling materials as ordered by the Engineer's Representative.

2.5 FINISH OF EXCAVATION AND INSPECTION

The Engineer's Representative shall inspect all the excavations before commencement of further work and the Contractor shall notify the Engineer's Representative when excavations are ready for inspection.

The Engineer's Representative may instruct the Contractor to test the bearing capacity of the soil in the bottom of excavations. Upon receipt of such instructions, the Contractor shall forthwith carry out such tests as the Engineer's Representative may instruct at the Contractor's expense.

Should the bottoms of excavation be found to be unsuitable as bearing surfaces as a result of such tests or inspection by the Engineer's Representative, the Contractor shall excavate further as directed until a satisfactory bearing surface is achieved.

No excavation shall be refilled nor any permanent work commenced until the formation has been inspected by the Engineer's Representative and his permission to proceed given. If required by the Engineer's Representative the bottom 150mm of excavation shall not be removed until just before the commencement of construction of permanent work.

2.6 REMOVAL OF WATER

The excavations shall at all times be kept free from stormwater, percolating water or subsoil water by any means necessary. The Contractor shall provide, maintain and clear away on completion any equipment necessary together with temporary drains and the like. Under no circumstances shall concrete be poured, fill placed, pipes laid or appurtenances installed in excavations containing water.

2.7 SHEETING AND SHORING

Sheeting and shoring shall be provided at excavations to ensure complete safety against collapse of soil at sides of excavations, to provide protection of workmen and to prevent damage to adjacent property, structures, paving and utilities.

2.8 STORAGE AND DISPOSAL OF EXCAVATED MATERIAL

Excavated material shall not be piled along sides of excavations in a manner that will overload or increase danger of collapse of excavation sides. All excavated material shall be neatly piled in stock piles but where this is not practicable the excavated material shall be removed from site.

Excavated material shall be separated into those suitable for fill and those unsuitable for fill as directed by the Engineer's Representative. Materials unsuitable for fill shall, as soon as practicable, be removed from site.

Material suitable for fill shall be put to immediate use or stockpiled at the option of the Contractor. Under no circumstances shall material declared to be suitable for fill be stored next to materials declared to be unsuitable for fill. Stockpiles of materials suitable for fill shall be located in areas as approved by the Engineer's Representative in the vicinity of the work, located so as not to interfere with the progress of the works. Stockpiles shall be kept in a neat, well drained workable condition at all times.

2.9 FILLING AND BACKFILLING

The excavated material arising from all excavations declared by the Engineer's Representative to be suitable for fill is to be used as filling. All other filling material shall be. Filling material shall contain no perishable or organic rubbish and no particles in excess of 150mm in diameter. The maximum dry density of the material shall be not less than 1600 kg/m³.

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

Filling and backfilling shall be placed in layers not exceeding 150mm thick (after compaction). Each layer shall be uniformly spread and shall be moistened or dried by aeration when required to ensure the optimum water content and shall be compacted uniformly by hand or machine methods of specified density as follows:-

Filling under footings, water tanks, concrete beds, side walks and other bearing situations	At least 98% maximum dry density
Fill within 300mm, measure horizontally, of foundation walls, retaining walls, edges of footings, and other below grade vertical	AT least 95% maximum dry density

surface. When machine compacted, compaction shall be by means of a 6 ton smooth wheeled roller.	
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The Engineer's Representative shall have the right to disapprove any compacting device of inadequate capacity or in his opinion, of type unsuited to the character of the material being compacted. 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 being compacted

Testing to determine the density of in-place soil shall be by means of ASSHO Standard Method of Test T147 or in accordance with BS 1377: 1975. The number of density tests per layer shall be as instructed by the Engineer's Representative.

When backfilling 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 backfilling shall be carried out in layers not exceeding 150mm thick. Each layer shall be compacted to 90% of the modified compaction. No backfilling 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.

Trenches shall not be backfilled until all required pressure tests have been performed and until the utility systems, as installed, conform to the requirements of the Specifications governing mechanical, electrical, and utility work.

Where, in the opinion of the Engineer's Representative, damage is likely to result from withdrawing sheeting, the sheeting shall be left in place. The trenches shall be carefully backfilled with approved backfilling materials, as hereinbefore specified, deposited in 150mm layers and thoroughly and carefully hand tamped until the pipe has a cover of not less than 300mm for electric ducts, and 600mm for sewers and water mains. Where the pipe is specially coated for protection against corrosion, care shall be taken not to damage the coating. The remainder of the backfill material shall then be placed in 150mm layers, and compacted by hand hammers or mechanical tampers to at least 90% maximum dry density. Settling the backfill with water will be permitted, and will be a requirement, when so directed by the Engineer's Representative. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for compaction, then refilled and compacted, with surface restored to the required grade and compaction, mounded over and smoothed off.

Trenches under buildings, open trenches across parking areas and trenches at other areas to be paved shall be backfilled as specified above, except that the entire depth of the trench shall be backfilled in 150mm layers and each layer shall be moistened and compacted to at least 98% of maximum dry density, to provide the required bearing value, so that construction or paving over the area can proceed immediately after backfilling is completed. Along all other portions of the trenches, the ground shall be graded to a reasonable uniformity and the mounding over of the trenches left in a uniform and neat condition to the satisfaction of the Engineer's Representative.

2.10 DISPOSITION OF EXISTING UTILITIES

Before commencing any construction work, the Contractor shall obtain from the various utilities Departments, Companies or Employer the location of any existing utilities on the Site. Active utilities on the Site shall be carefully protected from damage, relocated or removed as required by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the Record Drawings and both the Engineer's Representative and the utility owner notified in writing.

Inactive or abandoned utilities encountered during construction operations shall be removed, plugged or capped. The location of such utility shall be noted on the Record Drawings and reported in writing to the Engineer's Representative.

Active utility lines damaged during the course of construction operations shall be repaired or replaced as determined by the Engineer's Representative at the Contractor's expense. Immediately an active utility line is damaged the Contractor shall notify the Engineer's Representative and the utility owners by telephone and in writing.

2.11 SAFETY OF ADJOINING EXISTING BUILDINGS

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 also he shall

properly support all foundations, trenches, walls, floors, etc. affecting the safety of the adjoining existing buildings.

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.

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.

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.

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. The Contractor shall keep the Engineer 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 under this Clause.

The Contractor shall save harmless and indemnify the Employer in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever arising out of or in relation to any such matters in so far as the Contractor is responsible under this Clause.

2.12 DEWATERING

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 form 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. 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.

Continuous or permanent dewatering of the excavation or Site may not be undertaken without the written approval of the Engineer to the work and the methods to be employed which shall also comply with Codes of Practice and Local Authority requirements.

The water pumped from the excavations or well points shall be pumped to disposal points or sumps as approved by the Engineer and/or Local Authority and if so required be passed through settling tanks before disposal. Under no circumstances must water be disposed of in the Municipality's sewer systems.

2.13 SITE CLEARANCE

All areas of the Site specified for clearance or from which material is to be excavated or upon which filling is to be deposited shall be cleared of all obstructions, walls, and the like and bushes, hedges, trees and the like. Material so cleared shall be removed from Site by the Contractor.

2.14 DEMOLITIONS

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.

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.

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.

CONCRETE WORKS

- 3.1 Concrete
- 3.2 Construction Joints
- 3.3 Reinforcement
- 3.4 Mortar

3 CONCRETE WORKS

3.1 CONCRETE

3.1.1 Cement

Cement shall, unless otherwise stated, be Portland cement of an approved brand and shall comply with the requirements and shall satisfy the tests contained in British Standard No.12 or ASTM C-150 for cement Type 1.

Cement shall be of recent manufacture and shall be used within a period of 6 months of manufacture.

The Contractor shall with each fresh consignment of cement delivered to the site furnish the Engineer 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 Engineer. 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.

3.1.2 Normal Weight Aggregate

Fine aggregate for use in the production of concrete shall be of river sand and shall conform to the requirements of BS 882. Its grading shall be to Zones 1, 2 or 3 as defined in BS 882 and shall have not more than 10% retained on the 5 mm sieve.

Course aggregate for use in the production of concrete shall be composed of crushed gravel or stone. It shall conform to the requirements of BS 812 and shall have not more than 10% passing the 5 mm sieve.

Sources of aggregate shall be to the approval of the Engineer and samples of aggregate from the proposed sources shall be submitted to the Engineer at least 28 days before intended use. No new sources of aggregate will be permitted without prior approval of the Engineer.

Aggregates shall be sampled and tested in accordance with the appropriate Standards. They shall be free from salt and other organic impurities and shall contain not more than 0.03% by weight of chlorides nor 0.4 % by weight of sulphates.

Any aggregates which fail to meet these requirements shall be rejected and removed from the site, following which the Contractor's sources of supply shall be re-examined for suitability.

3.1.3 Water

Fresh water or MWSC water containing not more than 10 parts per million dissolved solids shall be used for all reinforced concrete work. It shall not contain vegetable matter, acid, sulphates, chlorides or other salts in such quantities as to cause efflorescence on the face of the concrete nor to effect adversely the setting time or strength of the concrete nor to instigate electrochemical corrosion of the reinforcement.

3.1.4 Storage

Storage accommodation for materials for use in concrete shall be subject to the approval of the Engineer and shall afford easy access for inspection and identification of each shipment in accordance with test reports.

1. Cement: The cement shall be delivered to site in the original sealed bags or containers from the manufacturer and shall be stored in a dry, weather-tight, properly ventilated structure, with adequate provisions for preventing the absorption of moisture and raised at least 15cm off the ground to prevent deterioration.

2. Coarse aggregate: Shall be stockpiled in separate gradings and protected against the inclusion of windblown dust, sulphates and other foreign matter.

When aggregates of different gradings are stockpiled close together the stockpiles shall be separated by bulkheads. The stockpiles are to be on concrete or other hard surface sufficiently sloped so that water is not retained in the base of the stockpiles. All aggregates are to be handled from the stockpiles in such a way as to secure a typical grading of the material, care being taken to avoid crushing the aggregates and contamination with extraneous matter.

3. Sand: Sand shall be stored under cover and sheltered from windblown dust, sulphates and foreign matter..

3.1.5 Mix Proportions

The Contractor, having knowledge of the source and type of cement, aggregates, plant and method of placing he intends to use for the aggregate/cement ratios and water/cement ratios which he considers will achieve the strength requirements specified and will produce a workability which will enable the concrete to be properly compacted to its full depth and finished to the dimensions and within the tolerances shown on the Drawings, shall be responsible for designing his concrete mixes within the following limitations. The aggregate/cement ratios and the water/cement ratio shall not exceed the upper limits specified below. Furthermore, the quantity of cement per cubic metre of concrete shall in no case be less than the minimum specified:-

Normal weight concrete grades	Characteristic compressive strength of cubes at 7/28 days		Maximum aggregate size (mm)	Maximum free water cement ratio	Kg of cement per cubic metre of compacted concrete	
	7 days	28 days			Max	Min
30 for on land structures and	21	30	20	0.42	450	350
40 for on water structures	28	40	20	0.42	450	350

As soon as possible after commencement of the Contract, the Contractor shall prepare such trial mixes as required to satisfy the Engineer that the specified concrete strengths will be obtained using the materials and mix proportions in accordance with the above clauses. The proportion of cement shall be increased if necessary to obtain the strengths required.

From each trial mix, six Preliminary Test Cubes shall be made and tested two at 7 days and four at 28 days, the test at 7 days being intended to give an early indication of possible variation from the required strength. If the difference between the highest and lowest results from any one trial mix is more than 15 per cent of the average of the strength test results, the test is to be discarded and a further trial mix made, unless all test results so obtained are above the required strength.

In TRIAL MIX the average compressive strength of the three cubes tested at 28 days shall exceed the specified characteristic strength by at least 10 N/sqmm

3.1.6 Batching and mixing of concrete

Concrete may be batched either by weight or by volume. It may be batched and mixed on Site or outside the Site and transported thereto.

When mixed outside the Site and transported to it, batching and mixing shall be in accordance with ASTM Specification C94 "Standard Specification for Ready Mixed Concrete".

When mixed on Site, batching and mixing shall be as follows;

Batching by Weight: The cement and each size of aggregate shall be measured by weight. The water may be measured by weight or volume. The weight batching machines used shall be of an approved type, and shall be kept in good condition while in use on the Works. Checks are to be made as required to determine that the weighing device are registering correctly.

Batching Aggregate by Volume: When batching aggregates by volume is allowed, the cement shall be batched by weight and the aggregate and water by weight or volume. Each size of aggregate shall be measured in metallic containers the depth of which is at least equal to their greatest width. The containers shall be of such shape that their volume can be easily checked by measurement.

Mixing Concrete: The location of the batching and mixing plant shall be approved by the Engineer.

Concrete shall be mixed in a batch mixer of an approved type and in good condition having a drum rotation about a horizontal or inclined axis. A continuous mixer shall not be used. Each mixer is to be fitted with a water measuring device having an accuracy within one percent (1%) of the quantity of water required for the batch.

The water measuring device shall be such that its accuracy is not affected by variations in the water supply pressure.

The batch shall be so charged into the mixer that some water (about 10%) enters the drum in advance of the cement and aggregates, water shall then be added gradually while the drum is in motion such that all required water shall be in the drum by the end of the first quarter of the mixing time. The concrete shall be mixed until a mixture of uniform colour and consistency is obtained.

The amount of concrete mixed in any one batch is not to exceed the rated capacity of the mixer. The whole of the batch is to be removed before materials for a fresh batch enter the drum.

On cessation of work, including all stoppages exceeding 20 minutes, the mixers and all handling plant shall be washed with clean mixing water. If old concrete deposits remain in the mixer drum, it shall be rotated with clean aggregate and water to clean out the drum prior to production of new concrete.

Concrete mixed as above is not to be modified by the addition of water or in any other manner to facilitate handling or for any other reason.

3.1.7 Placing

Concrete shall be conveyed from the mixer to its final position in any suitable manner, provided there is no segregation, loss of ingredients or contamination. It shall be placed in its final position before initial setting takes place and within 20 minutes of the addition of the water to the mixer. However, when agitating equipment is used to convey concrete such as in ready-mixed concrete, the elapsed time between the addition of the water and placing may be increased to 45 minutes.

The order of placing concrete shall be such as to prevent water from collecting at the ends, corners and along the faces of forms. It shall not be placed in large quantities at any given point and allowed to run or be worked over a long distance in the form. Whenever possible concrete shall be placed and compacted in even layers with each batch adjoining the previous one.

The thickness of each layers shall be between 15 and 30 cms as agreed with the Engineer. The layer thickness will depend on the width of forms, the amount of reinforcement and the need to place each layer before the previous one stiffens.

Concrete shall not be allowed to drop freely for more than 1.50 m. To convey the concrete as near as possible to its final positions, drop chutes of rubber or metal shall be used for small sections and bottom dump buckets or other suitable vessels for large sections.

Concrete shall be carefully compacted when placed to ensure a dense and uniform mass free from air holes and cavities. Concrete shall be compacted by vibrations. Vibration shall be performed by mechanical or electromechanical vibrators. The vibrators shall be of the plunger (poker) type for insertion in the concrete.

The poker type vibrators shall have a diameter compatible with spacing of reinforcement, a sufficiently high frequency and be properly handled by experienced personnel. They shall be immersed at regular intervals close enough to vibrate all the concrete, but not so close as to affect previously vibrated and partially set concrete. Each immersion shall continue until shortly after air bubbles cease to appear on the surface of the concrete, but shall not last more than 30 seconds. The vibrators shall be withdrawn gradually to ensure that no air pockets are formed.

All vibrations, compaction and finishing operations shall be completed within 15 minutes from the time of placing the concrete in its final position.

Concreting for any one part or section of the work shall be carried out in one continuous operation, and no interruption of concreting work will be allowed. Where beams and slabs together form an integral part of the structure, they shall be poured in one operation, unless provision is made to form a construction joint. A record is to be kept by the Contractor on Site of the time and date of placing the concrete in each portion of the works and the number and identification of the Works Tests Cube corresponding to these portions.

3.1.8 Testing

The frequency of testing shall be as noted in the clauses of this section. The Works Test Cubes shall be made at least once for each individual part of the structure as agreed with the Engineer.

At least six cubes shall be made at one time. Two of the six cubes are to be tested at 7 days. The remaining four cubes are to be tested at 28 days, and their average strength must not fall below the minimum strength specified and the lowest test result shall not be more than 20% below the average of the four cubes.

When the result of the 7 day test is unsatisfactory, The Contractor may elect to remove and replace the defective concrete without waiting for the 28 days test. If the result of the 28 day test is unsatisfactory, all concreting shall be stopped at the Contractor's expense and shall not proceed further without written permission from the Engineer.

If concrete is unsatisfactory, and where requested by the Engineer, the Contractor shall remove and test cores or conduct in-situ load tests from/on suspect portions of the works. Concrete found to be defective shall be cut out, removed and replaced by the Contractor at his own expense.

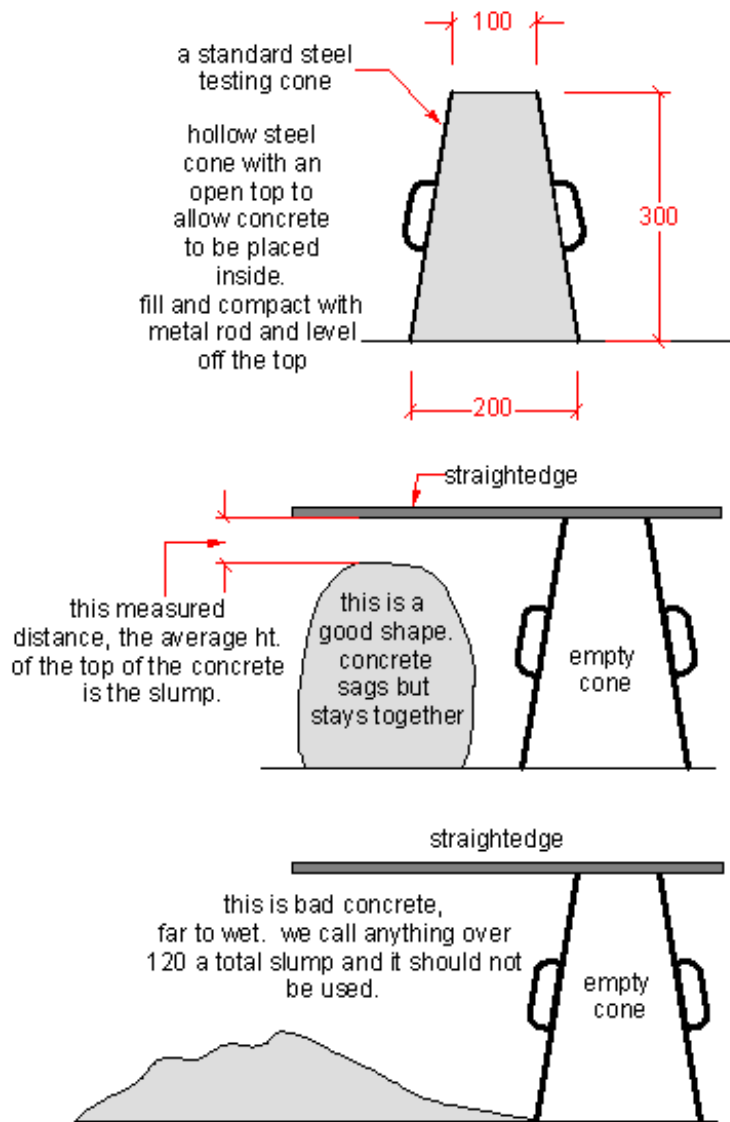
Slump Test

This test is vital for determining the consistency of concrete by filling a conical mold with a sample of concrete, then inverting it over a flat plate and removing the mold; the amount by which the concrete drops below the mold height is measured and this represents the slump. Recommended Slump is not more than 70mm

Below graphics describes how a simple test of slump test can be done on site

Procedure to determine workability of fresh concrete by slump test.

- i) The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil.
- ii) The mould is placed on a smooth, horizontal, rigid and nonabsorbent surface.
- iii) The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould.
- iv) Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section).
- v) After the top layer is rodded, the concrete is struck off the level with a trowel.
- vi) The mould is removed from the concrete immediately by raising it slowly in the vertical direction.
- vii) The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.
- viii) This difference in height in mm is the slump of the concrete.



3.1.9 Curing

Freshly placed concrete shall be protected from rain, dust, chemical attack and the harmful effects of heat, wind, flowing water, vibrations and shocks. This protection shall continue until the concrete is sufficiently set such that it can no longer be damaged by these factors which shall not be less than 24 hours after the time of placing.

Concrete shall be cured for at least 7 days or longer if instructed.

Timber formwork covering the concrete shall be moistened with water at frequent intervals to keep it from drying during the curing period. Metal formwork exposed to the sun must be shaded from its direct rays, painted white or otherwise protected during the curing period.

3.1.10 Formwork

The Contractor shall supply, design, erect, strike and remove the formwork and be entirely responsible for its stability and safety so that it will carry the wet concrete and all incidental loadings and preserve it from damage and distortion during its placing, vibration, ramming, setting and curing. It shall be so constructed as to leave the finished concrete to the dimensions shown on the Drawings and of a material capable of providing the surface finish specified. In any event, the maximum permissible deflection under all load shall not exceed 2mm or $1/600$ of the free span, whichever is less.

Formwork shall be constructed so as to prevent the loss of any liquid from the wet concrete and to be removable without shock to the partially set concrete. When the concrete is to be vibrated, all wedges must be nailed so as to prevent slipping or distortion.

Formwork shall be of timber and/ or metal and shall include all temporary concrete moulds and their supports.

For concrete surfaces which are to be plastered, clean sawn boards should be used.

For concrete surfaces which are to remain exposed wrought formwork shall be of timber framing lined with 12mm thick smooth polyurethane faced plywood or an equal approved lining or of metal, suitable to obtain a fair-faced finish on the concrete. Where columns or beams are shown as chamfered wrought hardwood fillet shall be planted in the angles of the formwork. Except where shown otherwise on the drawings, all exposed concrete corners and arises shall have a 15 x 15mm chamfer.

All formwork is to be thoroughly cleaned of any concrete or any other deposits. Immediately before concreting, formwork shall be thoroughly hosed down with water, temporary openings being provided to permit the escape of sawdust, shavings etc., with the water.

Wherever required and prior to placing of the reinforcement the internal surfaces of all formwork shall be treated with an approved mould oil.

Unless otherwise specified, the minimum period before striking formwork shall be as follows.

Columns	2 days
Beams, sides	2 days
Beams, soffits	21 days
Beam props	21 days
Suspended slabs, soffits	21 days
Slab props	21 days

Any work showing signs of damage through premature loading is to be entirely reconstructed at the Contractor's expense.

The Contractor is entirely responsible for the safe removal of formwork and all other temporary works.

3.2 CONSTRUCTION JOINTS

Whenever placing of concrete is discontinued within a bay or prior to completing a member, a construction joint shall be formed. Construction joints are to be made only along a horizontal or vertical plane except that in the case of inclined or curved members they shall be at right angles to the principal axis. Care shall be taken to prevent off-setting of the joint and to ensure watertightness.

Unless otherwise shown on the Drawings, construction joints will not be allowed in the unsupported sections of slab, beams and beamlike members. At construction joints the laitance film and porous layer of the already set concrete shall be removed and the surface keyed by hacking and then wirebrushed and thoroughly cleaned. Immediately before adding the fresh concrete, the surface is to be thoroughly wetted and a 10 mm thick coating of a fresh cement/sand mortar (having the same proportion of cement/sand as concrete in the mix) applied to the surface. The new concrete is then to be well compacted against the old.

3.3 REINFORCEMENT

Reinforcement shall be high yield deformed bars or mild steel complying with B.S. 4449 or welded wire fabric complying with B.S. 4483, except that the characteristic strength for mild steel reinforcement shall be 250N/mm² and for high yield steel shall be 415 N/mm².

High yield bars will be shown on drawings with T prefix. Mild steel bars will be shown on drawings with R prefix.

Reinforcing bars are to be stored clear off the ground and shall be truly straight. Suitable covering shall be provided to protect against windblown sulphates, chlorides and other deleterious matter.

Manufacturer's test certificates for all classes of reinforcement shall be supplied when required. Specimens sufficient for three tensile tests and three cold-bending tests per ten tonne of bars or fraction thereof and for each different size of bars shall be sampled. Testing shall be in accordance with B.S.4449 and batches shall be rejected if the average results for each batch is not in accordance with BS4449.

All steel is to be totally free from dirt, paint, loose rust or scale and is to be thoroughly brushed and cleaned after positioning and immediately prior to concreting.

The bars are to be accurately bent to the shapes indicated, and the bending must, wherever possible, be completed before the steel is fixed in position. Straight portions of bars must be true and bends must be kept out of winding. The internal radius of bends shall not be less than four times the diameter of the bar, except for stirrups and column binders. Great care is to be taken to bend stirrups and column binders to fit closely around the main bars. In the absence of reinforcement bending schedules the bending requirements of B.S. 4466 "Bending Dimensions of Bars for Concrete Reinforcement" or other similar approved standard shall govern.

Except where agreed by the Engineer all bars are to be bent cold.

Lengthening of bars by welding and rebending of incorrectly bent bars will not be permitted.

Unless otherwise stated splices in reinforcing bars shall be formed by lapping. Such laps in bars in any member shall be staggered. Except as otherwise indicated on the Drawings, the minimum overlap of lapped splices shall be 40 bar diameters or 30cm, whichever is greater.

The steel is to be fixed in position exactly as indicated and the bars are to be securely wired together with 1.6 or 1.4mm soft iron wire or approved spring steel slips wherever necessary to prevent any displacement during concreting. Spacers, chairs and the like, temporary or permanent, are to be used as required to ensure that the steel has the exact amount of cover indicated. No permanent spacers may show on a surface where a fair faced concrete finish or brushed aggregate finish are required.

Unless otherwise indicated, the minimum cover to the reinforcing bars and to binding wire shall be as follows:

POSITION	COVER mm
Main bars in columns	40-45
Main bars in floor slabs and soffits of roof slabs	30
Main bars in top of roof slabs	30-35
Bars in top ground slabs	30-35
Bars at faces in contact with soils	50-55
Clear cover in beams	35-40

The Contractor is to ensure that no steel is displaced from its position during the placement of concrete.

All reinforcement to be sprayed with water two hours before concreting commences.

3.3.1 Admixtures

Admixtures shall be used as specified by the Engineer. Prior approval of the admixture is required if the proposed admixture is different from what is specified in the drawing. Dir. The rates and methods of application shall be strictly in accordance with the manufacturer's written instructions.

3.3.2 Concrete Below Ground

All concrete faces below ground are to be protected as specified in the drawing and according to the manufacturer's written instructions or as approved by Engineer.

3.3.3 Tolerances

Except where otherwise noted on the Drawings, concrete surfaces shall be cast with the following tolerances:

Sizes of beams, thickness of walls	+/- 3mm
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Setting out dimensions, horizontal or vertical	+/- 6mm
Surface slabs	+/- 5mm
Verticality of columns, walls and straightness of beam faces	+/- 2mm in 3m (but not more than +/- 5mm overall)

3.3.4 Watertight Construction

All concrete work in swimming pools, plunge pools in-situ Jacuzzis and similar construction below the water table shall be watertight. Swimming pools located in the sea/lagoon and using sea-water do not need to meet this requirement.

The Contractor shall include in his rates for such **waterproof additives** as he deems to be necessary, subject to the prior approval of the Engineer, or as instructed on the drawings.

When in the opinion of the Engineer, damp patches or leakage of water in the finished work are due to failure of the Contractor to comply with the specification, the affected work shall be made good at the Contractor's expense.

Water bars shall be provided as shown on the drawings and at all construction joints and the type of water bar will be as specified or to the approval of the Engineer. All water bars shall be jointed and supported strictly in accordance with the manufacturer's instructions.

3.4 MORTAR

3.4.1 Description

Mortar for bedding kerbs, channels, cover frames etc shall be 1:4 cement: sand mortar.

Mortar for grouted stone pitching shall have 5% by weight of hydrated lime added to it.

Mortar for use with blockwork and rendering shall be 1:5 cement: sand mortar, and shall have a trial strength at 28 days of 7N/mm², (when tested in a 100 x 100 test cube).

3.4.2 Materials

Cement shall be Portland cement to BS12 and sand shall be a natural sand or crushed natural stone or a combination of both as specified in BS 1200.

3.4.3 Mixing

Mortar shall be mixed thoroughly either by hand or mechanically until its colour and consistency are uniform. The consistent materials shall be accurately gauged, allowance being made for bulking of sand. Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour shall be discarded.

Mortar plasticisers may be used with the Engineer's approval, but in no circumstances shall calcium chloride be permitted.

BLOCKWORK

- 4.1 Materials
- 4.2 Mortar
- 4.3 Workmanship
- 4.4 Load-bearing walls
- 4.5 Non load-bearing walls
- 4.6 Protection of finished blockwork
- 4.7 Compressible joint fillers
- 4.8 Polysulphide sealant
- 4.9 Lintols
- 4.10 Reinforcement
- 4.11 Source of materials
- 4.12 Storage of materials
- 4.13 Blockwork below ground level

4 BLOCKWORK

4.1 MATERIALS

Cement: Ordinary Portland Cement shall be used as described under concrete work. White or coloured cement shall comply with the physical requirements of B.S 12.

Lime: Lime shall be hydrated lime complying with B.S 890 Class B to be soaked in water for not less than 16 hours before use.

Water: Water shall be as described under Concrete Works.

Sand: Sand shall be as described under Concrete Works.

Concrete Blocks: Blocks shall be manufactured of cement and sand 1:5 mix (300 Kg cement to one metre cube of sand) made in vibrated pressure machines. They shall be hard, sound, square and clean with well defined arrises and shall be 400 mm (± 5 mm) long x 200mm (± 5 mm) high unless otherwise shown on the Drawings. The tolerance of thickness shall be (± 3 mm).

Unless otherwise shown on the Drawings blocks shall be hollow blocks and shall be of approved design.

Immediately after moulding, blocks shall be placed on clean, level, non-absorbent pallets. Blocks shall not be removed from the pallets until they have been inspected and approved by the Engineer. Blocks shall be steam cured for 14 days.

Blocks shall be tested for compressive strength whenever required by the Engineer. For each test twelve blocks will be selected by the Engineer. The average compressive strength for the gross area of hollow blocks shall be not less than 25 kg/cm² and the minimum block shall be 20 kg/cm².

Should a test not meet the above requirements, the batch of blocks from which the sample was taken, will be rejected and shall be removed from the Site.

Aerated Concrete Blocks: Shall conform to BS 8110 Part 2:1985 and BS 6073 Part 1:1981 for method of casting, density, thermal conductivity and strengths. Density of block shall guarantee good resistance to rain penetration as unprotected single leaf wall

4.2 MORTAR

Mortar shall consist 1 part cement to 5 parts of sand by volume. For work not in contact with earth or sand, one part lime may be added to the mix. Mortar for pointing facing concrete blocks shall be prepared using white cement. When blockwork is constructed below ground level sulphate resisting cement shall be used.

Should the Contractor wish to use a plasticiser with mortar, then the mortar shall consist of 1 part cement to 5 parts sand with plasticiser added and used strictly in accordance with the manufacturer's instructions. The plasticiser must be approved by the Engineer before use.

Mixing shall be carried out by means of an approved mechanical batch mixer. The mortar shall be mixed dry until a uniform mix is obtained. Sufficient water shall then be added and the mixing continued until a homogenous mix is obtained. Excess water shall not be used in the mix.

All mortar shall be used before the initial set has taken place and on no account shall mortar which has commenced to set be remixed with water or new batches and used.

4.3 WORKMANSHIP

Generally workmanship shall be in accordance to BS 8000.

Blockwork shall be set out and built to the respective dimensions, thicknesses and heights shown on the Drawings and/ or as instructed in writing by the Engineer.

Unless otherwise ordered, hollow blocks shall be used In all closures, end blocks such as at door jambs, window openings, etc., and blocks of special lengths or size, shall be solid. The blocks shall be well soaked before being used and the tops of walls left off shall be wetted before work is recommenced.

Blocks shall be laid in true and regular courses on a full bed of mortar of 10 mm average thickness, exclusive of any key in the jointing surfaces of the blocks. Sufficient mortar shall be used in bedding and jointing to ensure that all keys are solidly filled. Where blocks abut against concrete each third course shall be tied thereto by means of approved galvanised steel ties.

All horizontal joints shall be properly level. The Vertical joints shall be properly lined and quoins, jambs and other angles plumbed as the work proceeds.

All walls shall be plumbed vertical.

Standard sized block shall be used wherever possible. Broken blocks shall not be used except where required for bonding purposes. Walls and partitions shall be bonded to one another at angles and junctions.

Joints of faces of block walls which are to be rendered or plastered shall be raked out for depth of 10 mm as the work proceeds.

Walls shall be carried up regularly without leaving any part more than one metre lower than another unless the permission of the Engineer is first obtained. Work which is left at different levels shall be raked back.

The Contractor shall cut and fit blockwork as required, leave or form chases for edges of concrete slabs, steps, ends of partitions, etc cut chases for pipes, conduits, etc., and generally perform all cutting away for all trades. Wooden plates and door and window frames shall be bedded and exposed edges pointed in mortar and cramps shall be built in.

4.4 LOAD-BEARING WALLS

Load-bearing walls shall be constructed in accordance with B.S.C.P 111 Part 2.

Where a horizontal or vertical joint is not solidly filled or where it is found that the Contractor has used blocks other than the blocks specified the whole panel of wall will be considered suspect and will be removed and rebuilt at the Contractor's expense.

4.5 NON LOAD- BEARING WALLS

Non load-bearing walls shall not be constructed at the same time as the load-bearing walls but built at least two weeks after the roof or upper floor structure is completed. Toothing into load bearing walls will not be permitted.

4.6 PROTECTION OF FINISHED BLOCKWORK

The Contractor shall ensure that the finished blockwork walling is not damaged by subsequent operations.

The Contractor is to protect newly or partially built walling against it being dried out too rapidly by the sun's heat or from any other adverse climatic effects and is to follow the Engineer's instructions in this matter.

The Contractor shall in all cases cover all newly erected walling with hessian or other material approved by the Engineer and shall keep the same wet for at least three days.

4.7 COMPRESSIBLE JOINT FILLERS

Compressible joint fillers shall be used where specified at joints on drawings or requested by the Engineer. Filler shall be cut to exact widths and shall have all edges neatly trimmed. All fixing shall be strictly in accordance with the manufacturer's printed instructions.

4.8 POLYSULPHIDE SEALANT

Gun quality sealant shall be used where specified on the drawing or where requested by the Engineer including external joinery and metal work bedded against blockwork or concrete. The colour shall be to the approval of the Engineer.

The primer shall be supplied by the same manufacturer as the sealant. The joints will first be thoroughly cleaned to the satisfaction of the Engineer and shall be primed before sealing with sealant. Application of these materials shall be strictly in accordance with the manufacturer's printed instructions.

4.9 LINTOLS

Prefabricated lintols shall comply with the requirements of B.S 5977, Part 2. All lintols shall be bedded on cement and sand mortar and the Contractor shall allow for a minimum bearing at each end of 150 mm.

4.10 REINFORCEMENT

Plastic mesh reinforcement shall be used every connection to concrete.

4.11 SOURCE OF MATERIAL

All blocks for use in the works shall be obtained from a source approved by the Engineer. The Contractor shall not change same source without the written approval of the Engineer.

4.12 STORAGE OF MATERIALS

Cement shall be stored in a weatherproof ventilated housing off the ground and away from any source of water and dampness. These materials shall be stored in such a manner that they are used in rotation in order of delivery.

Sands shall be stored separately according to type, on clean concrete hard standings and protected from contamination.

Blocks shall be delivered to Site stacked and stored to permit ventilation and protected from rain, dampness and the like.

In the event that any materials for use in this Section deteriorate and become unusable due to inadequate and poor storage they shall be removed from Site as instructed by the Engineer and replaced at the Contractor's expense.

4.13 BLOCKWORK BELOW GROUND LEVEL

All blocks used in construction below ground level shall be solid.

ROOFING AND WATER PROOFING

- 5.1 General
- 5.2 Testing
- 5.3 Guarantee
- 5.4 Protection
- 5.5 Roofing
- 5.6 Water proofing
- 5.7 Water tank lining

5 ROOFING AND WATERPROOFING

5.1 GENERAL

Material shall be of the best quality and to the approval of the Engineer all in accordance with the relevant British Standards and Agreement Board Certificates.

Workmanship shall be to the highest standards and codes of practice.

5.2 TESTING

The Contractor is to test, to the satisfaction of the Engineer, all areas of roofing, waterproofing, terraces, bathrooms, and the like for water penetration. These tests are to be carried out after the membrane has been laid.

The Contractor is to allow in his rates for such areas to be flooded with water, and left for a minimum of 48 hours.

On completion of roofing works the Contractor is to leave the roof in a sound and watertight condition, to the approval of the Engineer, and in a satisfactory state for handing over.

5.3 GUARANTEE

The Contractor is to provide the Employer with a written guarantee to cover improper materials or faulty workmanship for a period of 10 (ten) years from the date of issue of the Final Certificate at the completion of the maintenance period. The Contractor shall bear the cost of any of the consequential damage as is provided for in same guarantee. The text of the guarantee shall be to the Engineer's approval.

5.4 PROTECTION

Finished and part finished surfaces shall be suitably protected to ensure no damage by other trades. Any roofing or waterproofing so damaged due to non-protection shall be removed and replaced at the Contractor's expense. The Contractor shall submit to the Consultant his proposed methods of protecting the various surfaces and locations prior to their completion or application of finishing layers, ie: tiling and the like.

5.5 ROOFING

The roofing shall comprise the following layers:-

1. Concrete screed, density 650-800 kg/m³, minimum thickness 30mm laid to falls and cross falls to drainage outlets. The screed shall be laid in bays not exceeding ten square metres and 300 mm wide from the edge with joints between bays in 10mm thick compressible fibre material.
2. Supply and apply one coat of approved priming /bonding course as per manufactures' instruction.
3. 4 mm elastomeric special polyester tropical grade modified bituminous felt, torch applied - black finish.
4. Skirting comprising waterproof membrane turned up and over fillet at roof perimeter up wall as per detail drawings. Allow for all two part polysulphide sealant and aluminium flashing.

5.6 WATER PROOFING

1. Prepare and apply two coats bitumen paint to all surface below ground level.
2. Apply primer and one layer self adhesive membrane, to Engineer's approval with end and side laps, applied as per the manufacturer's instructions to the concrete floors of all wet areas, including bathrooms, toilets, kitchens and the like including dressing into drainage outlets and the like, and turning membrane as skirting up all perimeter walls 300mm high and tucking into preformed groove.

3. As item (2) above to external walls of watertank and basement including one layer of 12 mm thick protection board (Bituminous impregnated).

4. As item (2) above to horizontal concrete surfaces and top of blinding as shown on drawings with 20mm thick screed protection layer over.

5.7 WATER TANK LINING

The internal floor, walls and soffit of the water tank shall be treated with a waterproof coating. The lining shall be formed by the mixing of two components resulting in a plastic, thixotropic and easily applied compound suitable for use on horizontal and vertical surfaces. Further properties of the lining shall be nontoxic and contain no chloride or other corrosive salts which could cause blooming.

All surfaces shall be clean and sound and free of dust, loose particles, cement laitance, grease, rust and other contaminants prior to application all to the Engineer's approval. Absorbant surfaces, (concrete, renderings and plaster) shall be pewetted with clean water and during application the surface shall be kept moist but free from standing water.

The lining shall be applied to the prepared surfaces in 2-3 layers, each layer not exceeding 1.5mm thickness. The total thickness shall not be less than 3mm overall. Curing shall be controlled so as to prevent the application drying out too quickly, particularly with respect to heavy winds and intense sunshine.

The Contractor shall submit to the Engineer for approval his water tank lining proposal and application of same shall be strictly applied in accordance with the manufacturer's printed instructions.

The Contractor to submit samples for Architect's approval.

METALWORK AND GLAZING

- 6.1 Generally
- 6.2 Standards
- 6.3 Finished coating
- 6.4 Samples
- 6.5 Sealing joints
- 6.6 Glazing
- 6.7 Glazing materials
- 6.8 Glass openings
- 6.9 Glass installation
- 6.10 Cleaning

6 METALWORK AND GLAZING

6.1 GENERALLY

The Contractor is required to employ approved specialists to supply, or supply and erect all metalwork items. Working drawings are to be prepared and issued to the Engineer in quadruplicate for approval in good time to afford no delay to the project and in no case less than eight weeks before work needs to be put in hand.

6.2 STANDARDS

Materials used in this Section shall comply with British Standards, the British Codes of Practice, DIN Standards, American Standards and American Society for Testing and.

Applicable provision of the following British Standards shall apply to these works as follows:-

1. Mild Steel shall comply with BS 4360, sections generally shall comply with BS 4: Part 1, hollow sections with BS 4848: Part 2 and angles with BS 4848: Part 4. Steel plate and sheet shall comply with BS 1449: Part 1 and steel tubes to BS 1775.
2. Stainless Steel Tubes shall comply with BS 3014, and stainless steel plate with BS 1449: Part 2.
3. Aluminium alloy extruded sections shall comply with BS 1161 or BS 1474 and aluminium alloy drawn tube with BS 1471. Anodising process when applicable to comply with BS 3987.
4. Brasswork as indicated on the drawings shall comply with the various appropriate Standards.
5. Fastenings unless otherwise specified shall be of the same metal as the item being fixed, with matching coating or finish. Wood screws shall comply with BS 1210. Bolts, Screws and nuts to BS 4190, machine screws and nuts to BS 4138 and self-tapping screws to BS 4174.
6. Plugs shall be proprietary fibre plastics or other approved type.
7. Bitumen solution for cold application shall comply with BS 3416, Type 1.

6.3 FINISHED COATING

6.3.1 General

The finished coating shall be as stated on the Drawings and applied strictly in accordance with the manufacturer's instructions.

The colour of the coating shall be selected from available ranges if not stated elsewhere in these Documents. The Contractor shall offer samples for approval prior to the final selection and the manufacturer of these elements.

6.3.2 Anodised coating

The aluminium anodising shall comply with BS 3987 and be integral colour hardcoat anodising 550kp/mm² hardness, minimum 60 microns thick.

The colour of anodising shall be as described on the drawings. Samples of colour including limits of colour variation shall be submitted to the Engineer for his approval before work commences. The

Engineer reserves the right to reject the products of any supplier who cannot guarantee a reasonable limit of colour variation, the acceptable limit of variation being at the Engineer's discretion. (Alucobond Company: <http://www.alusuisse-comp.com/>)

6.3.3 Polyester powder coating

All aluminium sections that are to receive a polyester powder coating shall be given a caustic etch followed by an anodix oxide treatment to obtain an Architectural class 1 anodic coating. Anodisation should be not less than 60 micron thickness.

All aluminium works shall be finished in coloured electrostatic polyester powder coating as per DIN standard 53151, 53152, 53153, 53156 or equal and approved to Ral colour subject to the Engineer's approval. (Alucobond Company: <http://www.alusuisse-comp.com/>)

6.3.4 Fluorocarbon finish (PVF2 or Kynar500)

Aluminium panels to be fluorocarbon finished to AS 2728 Category 3. Highly corrosion resistance high film build primer on both sides with a nominal film thickness of 25microns. Finish coat with a nominal thickness of 20microns to contain at least 70% Kynar500 or Hylar5000 resin. (Alucobond Company: <http://www.alusuisse-comp.com/>)

6.3.5 Epoxy Paint Coating

Mild steel dipped galvanised to be spray coated with Epoxy based paint shall be factory applied in two layers, primer coat 0.3 mils dry film thickness and finished colour coat minimum 1.0 mils dry film thickness, minimum overall thickness of 1.3 mils dry film thickness. Inside corners, channels and the like shall be visually covered to the extent possible. The Engineer shall select the colour from the range available.

The coating shall be applied to properly cleaned and pre-treated galvanised steel sections. Application shall be by approved applicators and the Contractor shall provide certified details of same. The pretreatment and application of the coating shall conform to all ASTM, BS, DIN Standards and the like as stated in the Supplier's printed Specifications.

6.3.6 Coating thickness

As and when instructed by the Engineer, the Contractor shall provide certificates from independent laboratories that the minimum thickness as stated in these Documents has been applied to the aluminium sections. Failure to provide such information shall result in the complete installation being rejected and replaced at the Contractor's expense.

6.3.7 Dissimilar materials

All aluminium surfaces that are to be in contact with cured concrete, mortar, steel and other metals shall have the contact surfaces protected wherever they may entrap moisture or corrosive elements. Metals that are to be in contact with mortar or concrete shall be protected with a two coat bituminous coating.

Prime paint steel parts of anchors, anchor inserts, reinforcement, supports, and all parts after field welding or bolting with zinc chromate. Minimum dry film thickness of 1 mil for zinc chromate.

6.4 SAMPLES

Submit duplicate samples of all finished materials for approval by Engineer. The samples will show the full range of finishes and mechanical properties to be expected in the finished product. Where physical samples would otherwise be too large, examples will be given that can be readily inspected locally, or the Contractor will provide facilities for the Engineer's inspection at the Contractor's expense.

Unless specifically called for, size and form of each sample shall be as directed by the Engineer.

6.5 SEALING JOINTS

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

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

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

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.

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.

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

6.6 GLAZING

Glass shall be in accordance with British and American Standards. It is to be entirely free from waves, scratches, bubbles, air holes, smoke wanes or similar defects.

The Contractor shall produce on request all invoices or advice notes from suppliers to confirm that the glass is of the standard specified.

Any scratched, broken or otherwise defective glass is to be removed and replaced by the Contractor at his cost during or on completion of the Works.

(Advanced Glazing Ltd: <http://www.advancedglazings.com/>); (PPG Glass Technology: <http://www.ppgglass.com/>);

6.7 GLAZING MATERIALS

6.7.1 General

The Contractor shall submit representative samples of all glass he proposes to install in the Works. On receipt of the Engineer's approval of same the Contractor shall commence the procurement of the glass.

6.7.2 Sheet Glass

Sheet glass shall be flat-drawn clear sheet glass complying with BS 952, Section 1, ref 4(a), 'Ordinary Glazing Quality'.

6.7.3 Reflective (Mirror) Glass

Sheet or float glass of 6mm thickness in gold or bronze finish. Total solar heat rejection shall be 75% to 78%. Edges shall be cut clean to avoid weak spots from which thermal cracks may develop. Special care is needed in glazing solar control glasses to accommodate thermal movement. The edge clearances must be at least 3mm all round for panes where neither dimension exceeds 750mm and 5mm where one dimension is greater. Similarly at least 3mm must be allowed between the faces of the glass and the upstands of rebates and glazing beads

6.7.4 Plate Glass

Plate glass shall be cast, rolled or drawn glass ground and polished on both surfaces complying with BS 952, Section 1, ref 6a(1), 'Glazing Quality for Glazing'.

6.7.5 Obscured Glass

Obscured glass shall be figured rolled glass complying with BS 952, Section 2, ref 14b of approved type.

6.7.6 Wired Glass

Wired glass shall be polished Georgian wired glass having both surfaces ground and polished and with square mesh inserted during rolling complying with BS 952, Section 4, ref 21b.

6.7.7 Mirrors

Mirrors shall be of uniform thickness, free from waviness, air bubbles and the like. Representative samples of mirror shall be submitted for the Engineer's approval. The mirror glass shall be clear and silvered by nitrate precipitation, protected by copper plating with a protective plastic coating on the reverse side. The mirrors shall be 6 mm thick and cut to sizes as shown with ground and polished edges. The mirrors shall be set on 20 mm thick plywood backing plugged and screwed to wall.

6.8 GLASS OPENINGS

The glass framing shall both structurally support and adequately cushion the glass. To prevent mechanical and thermal stresses on the glass, the framing system shall provide openings that are within the tolerances for squareness, corner offset and bow. These tolerances are listed below.

Squareness	- 3mm difference in lengths of the diagonals.
Corner Offsets	- 0.8mm maximum offsets at corners.
Bow	- 1.6mm bow in a 1.22m length of frame.

If the variations from these tolerances are anticipated, details of same shall be advised to the Engineer. If site conditions are found to be outside these tolerances corrections must be made before the openings are glazed.

6.9 GLASS INSTALLATION

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

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.

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.

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.

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

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

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 Engineer.

6.10 CLEANING

All glass shall be thoroughly cleaned and polished on both sides and all paint spots and the like completely removed to the satisfaction of the Engineer.

CARPENTRY & JOINERY

- 7.1 Timber generally
- 7.2 Timber grades
- 7.3 Timber for carcassing
- 7.4 Softwood for joinery
- 7.5 Hardwood for joinery
- 7.6 Preservative treatment
- 7.7 Fire resistance and flame retardants
- 7.8 Plywood
- 7.9 Plastic laminate
- 7.10 Hardboard
- 7.11 Nails and screws
- 7.12 Metalwork
- 7.13 Adhesives
- 7.14 Access panels and the like
- 7.15 Workmanship
- 7.16 Packaging and storage
- 7.17 Doors/Windows
- 7.18 Protection, Finishing and re-examination
- 7.19 Screens
- 7.20 Ironmongery
- 7.21 Service ducts and access panels
- 7.22 Drywall partitions

7 CARPENTRY & JOINERY

7.1 TIMBER GENERALLY

Joiner's work shall be carried out in accordance with the drawings and the principles of first class construction.

Full details of the timber to be used are to be submitted to the Engineer and the quality for any purpose is to be approved before any timber is delivered to site.

The timber is to be of the best quality available having due regard for the purpose for which it is required and it is to be seasoned to a moisture content of 14%-15% before transportation.

The Contractor is to take a site reading to determine the moisture content of all joinery by Moisture Meter. Documentation is to accompany each batch shipped to verify the moisture content. Without such documentation the whole batch will be rejected.

The Engineer shall reject all unsound timber caused by decay, insect attack, sapwood, splits, shakes, and waney edges, pith pockets, together with large, loose or dead knots.

Unless stated otherwise, sizes shown on drawings are finished sizes.

7.2 TIMBER GRADES

All timber shall be of grade C27 (BS) or higher. Red Meranti may be considered to be approximately equivalent to C27. Where other timbers are necessary they are specified on relevant drawings.

7.3 TIMBER FOR CARCASSING

Timber for carcassing generally is to be Red Meranti (prime grade), free from decayed or loose knots, splits and any sign of fungus/live insect attack, and to the approval of the Engineer.

The structural timber wood is to be straight, close grained, with not less than eight annular rings to 25 mm. Unless otherwise described all sawn members are to be of a permissible species which has

been visually or machine stress graded and which meets the requirement of BS 4978 may be used with the Engineer's permission.

7.4 SOFTWOOD FOR JOINERY

The timber for joinery is to be Red Meranti (prime grade) or other equal and approved, selected for joinery work.

Joinery timber is to be selected with due regard for the particular purpose for which it is to be used, Appendix A of BS 1186 (Part I) being used as a guide.

Where indicated on the drawings, softwood for first or second fixings is to receive a paint or stain finish on exposed surfaces.

7.5 HARDWOOD OR JOINERY

Hardwood for joinery is to be first quality Balau unless otherwise stated, and it is to be suitable for its intended use in accordance with Appendix B of BS 1186 (Part I).

Hardwood for joinery is to be quarter sawn unless otherwise indicated and is to show a straight and regular grain throughout without shakes or other defects which would reduce the mechanical or physical properties of the timber. Timber in the finished joinery is to be free from wooly texture, soft heart, sapwood, splits, shakes, dote, all evidence of fungus/insect attack and all faults caused by compression failures. There are to be no waney edges. It is to be free from unsound knots and there are to be no knots of any description on exposed faces, unless specifically agreed. Plugging or piecing in will not be permitted.

Colour of hardwood throughout is to be consistent and to the approval of the Engineer.

7.6 PRESERVATIVE TREATMENT

The preservative treatment to all timber shall comply with the requirements of BS 5268 or equivalent for any species not listed therein. The Contractor shall provide a certificate of assurance that treatment has been carried out as specified. Any ends cut after treatment are to be given two coats of preservative. Factory fabricated timber and components shall be treated therein.

7.7 FIRE RESISTANCE AND FLAME RETARDANTS

All timber, plywood and boarding shall comply with the requirements of BS 476 and 5669 in respect of fire resistance and the application/treatment of flame retardants. The Contractor shall provide a certificate of assurance that such compliance/treatment has been carried out as specified. (PyroGuard: <http://www.frtw.com/>)

7.8 PLYWOOD

Plywood generally is to comply with BS 1455, and is only to be obtained from a manufacturer approved by the Engineer.

The plywood bonding is generally to be type WBP, except where otherwise stated. The Contractor is only to use plywood of the required thickness, and under no circumstances is he to make up thickness by gluing together sheets of thinner plywood.

The surface grading is to be Grade 1 where to receive clear finish and Grade 2 elsewhere, unless otherwise described. The Contractor is only to use a fine tooth saw when cutting plywoods.

7.9 PLASTIC LAMINATE

Decorative plastic laminate (melamine) sheeting shall comply with BS 3794 Class 1.

The sheeting shall be capable of being postformed at the edges without cracking, breaking, chipping or the like. Under no circumstances shall edges be stuck on but formed from whole sheets covering the main body of the item of work.

Only whole sheets shall be used and fixing of the sheeting shall generally be as stated above for Veneers. VGS class laminate shall generally be used for doors while HGP class laminate shall be used for all other applications including post forming. Selection of laminate and choice of colour all to the approval of the Engineer.

7.10 HARDBOARD

Hardboard is to be standard quality in accordance with BS 1142 Part 2.

7.11 NAILS AND SCREWS

Nails are to comply with BS 1201 and screws with BS 1210. They are to be of the appropriate approved type for their intended use.

7.12 METALWORK

Metalwork fixings are to be galvanised and of a make and pattern approved by the Engineer.

Bolts are to comply with BS 4190.

Fixing accessories are to comply with BS 1494.

Timber connectors are to comply with BS 1579.

Expanding bolts to the approval of Engineer.

7.13 ADHESIVES

Adhesives are to be synthetic resin type complying with BS 1204 Part 1, and they are to be type WBP.

7.14 ACCESS PANELS AND THE LIKE

The Contractor is to provide access doors, panels and traps to the complete satisfaction of the Engineer, wherever access may be necessary in order to maintain the services within the building.

Accesses which are likely to be used regularly are to be formed with hinged lockable panels; those used irregularly are to be capable of being removed by releasing screws or clips.

7.15 WORKMANSHIP

Joinery shall comply with BS 1186 Part 2 and CP 112 for structural carpentry, and where possible shall be fabricated in a manufacturer's shop prior to delivery. It shall be accurately, properly and soundly constructed with all moulds and arrises clean and sharp. Joinery shall be protected from damage during storage at Site and throughout the construction period subsequent to fixing.

The terms "frame" or "framed" or "framing" mean work put together by proper carpentry or joinery joints, such as morticing and tenoning, dovetailing, dowelling, etc., and the joints are to be as shown, specified or directed. Butted and screwed or nailed joints or halved joints and the like will not be deemed framed and will not be accepted for framed work.

Fixing of all joinery work, including fillets, architraves, frames, glazing beads and the like shall be by means of screws. Nailed work will not be permitted.

Screw heads in work to be painted shall be countersunk and stopped. Screw heads in wood to be oiled, varnished or polished shall be pelltated, with the grain of the pelltat in the same direction as the grain of the member.

Unless otherwise described, work described as "plugged" shall be fixed by drilling holes in the wall or floor, plugging with "Plastic Plugs" well rammed in and fixing the member with screws. Centres of the fixings must not exceed those necessary to provide adequate support, and in any case must not exceed 600 mm.

7.16 PACKAGING AND STORAGE

All timber and composite items are to be polythene wrapped at 14% moisture content before transportation.

The timber is to be properly stored and protected on site until immediately prior to fixing when the polythene is to be removed and the timber stacked above the ground in the shade.

The Contractor is to ensure that the timber is covered in wet weather and uncovered in dry weather and is to replace any damaged or otherwise affected items at his own expense.

All factory fabricated units and components shall be stored in their packing until fixing of same commences to ensure that damage is kept to a minimum.

7.17 DOORS/WINDOWS

Doors shall be properly fitted to give a uniform clearance of not more than 3 mm all round and hinges shall be let into doors and frames.

Flush doors are to be constructed in accordance with BS 459 Parts 1 and 2. All edges are to be lipped with hardwood lipping tongued into the edge of the door.

Flush doors generally shall be solid core flush faced with a veneer finish prepared to receive decoration.

The core of solid core flush doors shall be constructed of longitudinal laminations of precision planed timber, butt jointed and glued with resin based adhesive under hydraulic pressure, the whole forming a rigid, fire resistant raft.

All doors, solid/semi solid core, shall be constructed with blocking pieces to receive hinges, door closers and other ironmongery as specified.

Where flush doors are to have an observation panel or are to receive a grille panel the framing of the door must be designed to suit the required size of panel and must be properly framed and rebated around all sides of the panel. Loosely fixed hardwood glazing beads of adequate size are to be provided with the door when delivered to the site for removal and later final fitting.

Where flush doors are to have rebated or rounded stiles the lippings at the edges must be increased sufficiently to allow for these labours. Cutting rebates or forming roundings on standard sized lippings will not be permitted.

Fire doors shall have a 2 hour fire rating unless otherwise described, and shall generally be constructed in accordance with the relevant British Standard or DIN Standard. All fire doors shall be fixed with an intumescent strip insert in their frame. (Adams rite fire doors: <http://www.adamsrite.com/>)

7.18 PROTECTION, FINISHING AND RE-EXAMINATION

All the wood for joinery works, whether it is to be painted or left clear finished, shall be supplied properly planed and rubbed down.

The joinery shall be properly protected during fixing and work by other trades, especially frames and door linings which may require temporary casings.

The frames shall be fitted with a temporary threshold to retain frame shape which can be removed before floor finishes are laid.

Units supplied "pre-finished" (veneered doors, pre-painted doors etc) shall be supplied with an appropriate wrapping, and the Contractor shall repair or replace any defective work, no matter from whatever cause, in order to hand over the works in perfect condition.

After the setting, placing and fixing of the joinery, the Contractor shall examine all the works and ensure that they are fixed correctly. Until the issue of the Practical Completion Certificate and handover of the entire work, the Contractor shall replace at his own expense, all missing or defective parts.

At the end of the works, the Contractor shall check all opening units and their proper functioning, and shall grease all moving parts, if necessary.

After handover, the Contractor shall maintain his work and shall, on request, carry out all easing and adjustments as required.

In the case where defects appear especially, twisting of doors and the like, the Contractor shall rectify such defects at his own expense.

7.19 SCREENS

Screens shall be manufactured from solid hardwood to patterns and designs as described and directed by the Engineer. All screens shall be manufactured in accordance with the requirements of this section of the work.

7.20 IRONMONGERY

7.20.1 General

All ironmongery shall be selected for the appearance and performance required and shall be obtained from a well known reputable manufacturer and shall bear the stamp of the manufacturer. Unless specified otherwise all ironmongery shall be supplied from the same manufacturer.

The Contractor shall not use in the works types or classes of ironmongery other than those specified except with approval in writing of the Engineer.

The type, location, quality and finish of ironmongery shall be as shown on the drawings and the Contractor shall submit for approval a comprehensive schedule of ironmongery covering all items required to complete the works. This schedule shall give catalogue references and locations for all ironmongery.

All screws used for fixing ironmongery shall be supplied and shall be of the correct type, material, finish, size and shape to the satisfaction of the Engineer.

The base metals for finishes shall be as follows:

- aluminium finish : aluminium
- nickel plated : bronze or brass
- stainless steel finish : stainless steel

7.20.2 Workmanship

All ironmongery shall be carefully wrapped and protected until the completion of the work and any items or parts which are damaged shall be replaced at the Contractor's expense before hand-over of the works.

Any locks with steel components which are to be used in or near damp rooms shall be hot galvanised and painted before fixing.

All ironmongery shall be securely fixed or housed and all rebates, holes, etc., to take ironmongery shall be neatly and cleanly executed.

All hinges shall be carefully housed or let into the hinged elements and to the frames.

Intumescent paste shall be applied around all ironmongery to be fixed on fire doors.

All fitting shall be removed before starting any painting operations and refixed in place after all painting work is completed and approved by the Engineer.

The Contractor shall check and adjust all ironmongery, and oil or grease moving parts to ensure good performance.

On completion, all locks, catches and similar types of ironmongery shall be properly cleaned, tested and oiled or greased.

7.20.3 Suiting

Locks shall be selected from a range of ironmongery having compatible keys. It will be a requirement that the locks shall be so arranged as to accept a common master key and sub-divided so as to offer a number of sub-master keys.

All locks shall be provided with three keys, which on completion of the work shall be clearly and securely labelled with 50 X 20 mm metal tags securely fixed to the keys and delivered to the Engineer.

7.21 SERVICE DUCTS AND ACCESS PANELS

Provide service ducts and access panels to sanitary appliances and fittings, dry riser, electric panel and the like as shown on detailed and location drawings. Ducts and panels shall generally be demountable comprising plywood board fixing to galvanised steel frames with countersunk machine screws. All framing to be galvanised and painted. Outside face of ducts and panels shall be finished to receive the adjacent wall finish. Externally located ducts and panels shall be constructed accordingly using only properly treated materials.

Size of service ducts and access panels shall be as shown. Contractor to provide details of proposed framing and fixing details for Engineer's approval prior to commencing work.

7.22 DRYWALL PARTITIONS

The drywall partitions shall comprise and be constructed using the following specifications:

7.22.1 Materials

All materials to be of Gyproc from British Gypsum or equal and approved.

Drywall partitions shall be installed according to the manufacturer's instructions. All materials to have Engineer's approval prior to commencement of Works.

Internal drywall partitions will have a total thickness of 75mm, 0.5 hour fire resistance and 44 decibel average sound reduction index. Two hour resistance drywall partitions shall include fire resistant lining to give specified rating.

Drywall partitions having glazing vision panels shall consist of two 6 mm clear monolithic float glass with H.W frame and beading covering the full width of the wall.

7.22.2 Metal Studs

Metal studs and channels of 48 mm width to be made of light weight cold rolled, galvanised mild steel to comply with BS 2989 and BS 2994. Vertical studs shall be installed at 600 mm maximum centres.

Damp-proof membrane will be inserted under the floor channel.

7.22.3 Plasterboards

Gypsum plasterboards of 12.7 mm thick to comply with BS 1230, shall be screwed to the studs, carefully cut and jointed.

Plasterboards towards wet areas such as bathrooms, toilets and kitchens will be fixed 10 mm above floor level to allow for caulking.

The lining shall be skimmed with taped joints to receive finish.

7.22.4 Insulation

All drywall shall receive a 40 mm resin bonded glass wool slabs, 68 kg/m³, to be installed between the plasterboard linings.

7.22.5 Services

Prior to installing insulation and plasterboard on second side, all pipes, switchboxes, etc. will be fixed, inspected and tested if required.

Heavy fixtures such as lavatory cisterns and hand basins shall have a timber frame inside the partition with vertical and horizontal members to take the required fixings.

STRUCTURAL STEELWORK

- 8.1 Design
- 8.2 Material properties
- 8.3 Testing of materials
- 8.4 Fabrication standard
- 8.5 Detailing of connections
- 8.6 Submissions
- 8.7 Welding
- 8.8 Electrodes for welding
- 8.9 Welding operators
- 8.10 Testing of welding
- 8.11 Site welding
- 8.12 Bolted connections
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- 8.14 Damaged material
- 8.15 Galvanising
- 8.16 Preparation of steelwork for protective treatment
- 8.17 Painting generally
- 8.18 Application of protective layers
- 8.19 Bolts
- 8.20 Materials for steelwork protection
- 8.21 Schedule of protective treatment
- 8.22 Painting of galvanised bolts etc after erection
- 8.23 Erection
- 8.24 Bedding of steelwork
- 8.25 Particular requirements

8 STRUCTURAL STEELWORK

8.1 DESIGN

The design of structural steelwork shall be in accordance with BS 449.

8.2 MATERIAL PROPERTIES

Steel for rolled sections, plates and bars shall comply with BS 4360 Grade 43C.

Dimensional properties, tolerance and rolling margins shall conform to the relevant British Standards.

The condition of steel for fabrication shall be Grade C of Swedish Standard 05 59 00.

Black bolts and nuts shall comply with BS 4190 metric.

Washers shall comply with BS 4320.

High strength friction grip bolts shall comply with BS 4395 Part 2.

8.3 TESTING OF MATERIALS

The Contractor may be required to perform tests as instructed by the Engineer and submit test certificates for the materials to be used in the work. The tests shall include the following in accordance with BS 4360.

- ◆ Chemical analysis
- ◆ Tensile tests

- ◆ Bend tests
- ◆ Flattening tests

The tests shall be carried out by an approved testing authority and notice shall be given to the Engineer of the intended execution of any such test. The cost of such tests shall be borne by the Contractor.

If any sample fails a test, the consignment it represents may be rejected in part or in whole at the Engineer's discretion.

8.4 FABRICATION STANDARD

The work of fabrication and erection shall comply with the requirements of BS 449.

Fabrication accuracy shall be within the following limits:

- ◆ Length : 3 mm
- ◆ Twist and Deviation : 1 in 1000

8.5 DETAILING OF CONNECTIONS

Detailing of connections shall ensure that inaccessible pockets/gaps are avoided. In this respect back-to-back angles with spacers, and similar details which would prevent full accessibility for painting, are not acceptable.

Where cope holes are required to allow completion of butt welding they shall be of adequate size to allow fillet welding to seal the connection while still allowing full accessibility for subsequent painting.

Sniping of stiffeners at the root radii of rolled members is not acceptable. Stiffeners shall be cut to the required profile to fit closely into all such radii, and seal welded in accordance with Clause 9.7.

8.6 SUBMISSIONS

Shop drawings for approval shall be submitted at least four weeks before starting fabrication. Material shall not be ordered nor fabrication commenced until shop drawings are approved in writing by the Engineer.

The Contractor shall prepare and submit details of erection procedures at least four weeks before commencement of steel erection.

8.7 WELDING

Metal-arc welding of steel to BS 4360 shall be in accordance with the requirements of BS 5135.

Run-on/Run-off plates shall be used during butt welding.

Fillet welds shall be continuous to form a complete seal where structural elements join or abut.

8.8 ELECTRODES FOR WELDING

The Contractor shall obtain approval for the types of electrodes proposed for use. Welding electrodes shall give a weld deposit with mechanical properties not less than the minimum specified for the parent metal; they shall comply with BS 639. Hydrogen-controlled electrodes shall be used for butt-welding of steel over 25mm thick.

8.9 WELDING OPERATORS

Welders employed on the work shall be tested to BS 4871 and BS 4872 Part 1. Welding shall be carried out under the supervision of a competent welding technologist and the test pieces shall be tested to BS 4870.

8.10 TESTING OF WELDS

The Contractor shall make radiographic examination of butt welds in accordance with Section 8 of American Petroleum Industry (API) Standard 1104 and carry out dye-penetrant tests in accordance with BS 4416.

In general 10% of the length of each butt weld shall be radiographically inspected and 10% shall be tested using penetrant, 5% of the length of each fillet weld shall be tested using penetrant. The location of lengths to be tested shall be as directed.

8.11 SITE WELDING

The Contractor may, subject to prior approval, use site welding as an alternative to bolted connections.

Site welded joints shall be inspected by radiography in accordance with Section 8 of API Standard 1104. Initially 100% of each but weld shall be inspected.

If approved the number of inspections may be subsequently reduced.

Finished welds shall comply with Section 6 of API Standard 1104. Defective welds shall be cut out, remade, and retested as approved.

8.12 BOLTED CONNECTIONS

The threaded portions of bolts shall be outside the parts bolted together and the ends shall protrude by at least one complete thread and by not more than three complete threads beyond the outer face of the tightened nut.

Holes shall not be distorted or enlarged by the use of drifts.

High strength friction grip bolts shall be fitted in accordance with BS 4604 Part 2.

The use of load-indicating washers shall be in accordance with the manufacturer's recommendations.

8.13 TRANSPORTATION AND STORAGE

Steelwork and protective coating shall be protected from damage during packing, handling, transportation and storage.

The Contractor shall ensure that members are not subjected to greater stresses than those allowed in BS 449 during fabrication, transportation, storage and erection.

Stored members shall not be in contact with each other and shall be clear of the ground.

8.14 DAMAGED MATERIAL

Steelwork deemed to be damaged beyond repair in transit shall be replaced.

The Contractor shall obtain prior and final approval for remedial work to damaged material.

8.15 GALVANISING

Galvanising of steelwork if required shall be carried out after fabrication is complete. Steelwork required to be galvanised shall be pickled in dilute hydrochloric acid then washed, fluxed and stoved, and coated with zinc by dipping in a bath of molten zinc. Components shall be immersed in the bath only for a period sufficient to attain the temperature of the bath and shall be withdrawn at a suitable speed so that a minimum coating of 610 g/m² of surface (85 microns min. DFT) is achieved. Components shall be covered evenly on all surfaces.

Items described as heavily galvanised shall be grit blasted prior to galvanising and receive a minimum coating of 1000 g/m² of surface (140 microns min. DFT).

Lightweight gauge metal work shall be galvanised by the hot-dip process as specified in BS 3083 or BS 2989.

Contact between galvanised steel members and aluminium surfaces shall be prevented by means of an approved insulating layer.

Galvanised steelwork shall receive specified paint treatment and shall be cleaned, degreased, abraded and etch-primed beforehand.

8.16 PREPARATION OF STEELWORK FOR PROTECTIVE TREATMENT

Surfaces shall be cleaned to BS 4232 before any protective treatment is commenced. Steelwork shall be degreased and shot or grit blasted to SA 2½ quality standard with a surface amplitude of 50-75 microns to remove rust and mill scale; dust and debris shall be removed by vacuum cleaner, compressed air or brush. Site welds and adjacent steel work shall be blast cleaned and similarly prepared. Surface defects shall be removed in accordance with BS 4360.

Regular mill scale detection tests shall be made using the Copper Sulphate method.

Blasting operations and painting processes shall be segregated.

8.17 PAINTING GENERALLY

Paint shall be applied by brushing or spraying in accordance with the manufacturer's permitted percentages. Viscosity tests shall be carried out on random samples of mixed paints as directed. Brushes stored in thinners shall be worked out to remove thinners before re-use.

Painting shall not be carried out when the steelwork temperature is below 4° C or above 38° C, or less than 3° C above dew point, nor when the relative humidity is above 80%.

Stripe coats shall be applied to welds and steel edges before painting.

Strong paint films shall be achieved on all cleats, arrises, boltholes, bolt heads and the like.

Protective treatment other than the site-applied coatings shall be applied under factory conditions in an enclosed shop. Completed coats shall be checked for continuity by a low-voltage wet-sponge holiday detector and for thickness by an Elcometer.

If a required film thickness is given it shall be the minimum dry film thickness (DFT) as measured by an Elcometer; the Elcometer shall be calibrated for each coating by the use of a shim of known thickness placed upon the shot-blasted blank or the underlying coat, and the shim shall correspond with the theoretical film thickness of the surface of coating shall be applied in accordance with the rate of coverage recommended by the manufacturer having regard to the surface profile of the steel and the conditions of application.

Sample plates shall be prepared for approval and shall thereafter be adopted as the standard to be achieved in the finished work.

The Contractor shall prevent dust and dirt coming into contact with freshly painted surfaces.

Before the site painting coats are applied, the surfaces shall be washed with clean water to remove salt and other impurities.

Paint shall not be applied to the embedded portions of metal items except for the portions within 75mm of the finished concrete surface.

8.18 APPLICATION OF PROTECTIVE LAYERS

Blast-cleaned surfaces shall be kept dry and over-coated within 4 hours of the start of cleaning (2 hours for outdoor blast-cleaning). They shall be treated in accordance with the protective treatment schedule, except faying surfaces for HSFG connections.

8.19 BOLTS

Bolts, including friction-grip bolts, nuts and washers shall be hot-dip spun-galvanised in accordance with BS 729. The threads of nuts may be re-tapped as provided for in that Standard.

Faying surfaces of high-strength friction-grip connections shall be blast cleaned to Sa 2½ quality standard, masked within two hours to exclude air and only exposed just before bolting-up. Paint or contaminants shall not be allowed on faying surfaces.

8.20 MATERIALS FOR STEELWORK PROTECTION

Materials for steelwork protection shall be from a reputable, certified manufacturer.

8.21 SCHEDULE OF PROTECTIVE TREATMENT

8.21.1 Alkyd Finish Paint System

Protective treatment to steelwork shall be in accordance with the following schedule:

TREATMENT Min. DFT	microns
Blast clean to Sa 2½ quality standard surface amplitude 50-75 microns	-
Holding primer	(20)
Zinc phosphate, epoxy primer	75
Micaceous iron oxide epoxy	100
Oil modified alkyd undercoat	40
Oil modified alkyd high gloss finish (colour as directed)	40

Damaged paint work shall be blast-cleaned if bare metal is exposed or corrosion is present. If the primer is intact the surface shall be prepared by power wire-brushing. The prepared surface shall be protected with coatings 4, 5 and 6, each to the minimum DFT.

8.21.2 Galvanised plus Alkyd Finish Paint Sytem:

TREATMENT Min. DFT	microns
Degrease galvanised surfaces with G.500 water rinsable cleansing solution	-
Lightly abrade	-
Check for paint acceptability 'T wash' mordant solution	-

Paint application shall not proceed until this check indicates, by the development of a black conversion coating, that the entire surface is suitably prepared to receive paint.

Rinse with fresh water and dry	-
Metallic lead primer	50
Micaceous iron oxide epoxy	-
Oil modified alkyd undercoat	-
Oil modified alkyd high gloss finish (colour as directed)	40

Damaged paintwork shall be blast- cleaned if bare metal is exposed or corrosion is present. If the primer is intact the surface shall be prepared by power wire-brushing. The prepared surface shall be protected as follows:

Where primer is intact:

- ◆ Touch up with coatings 6, 7 & 8 each to the min. DFT

Where blast cleaning is necessary:

- ◆ Apply two coats of metallic lead primer to a minimum DFT of 150 microns
- ◆ Touch up with coatings 7 & 8, each to the minimum DFT

8.22 PAINTING OF GALVANISED BOLTS ETC. AFTER ERECTION

Following erection galvanised boltheads, bolt ends, nuts and washers shall be degreased with G.500 cleansing solution and abraded and painted to the specification of adjacent steelwork.

8.23 ERECTION

The Contractor shall unload all materials and plant on site and shall provide tackle plant and packing necessary for the erection of the steelwork including any temporary bracing. No joints shall be finally connected together until all the steel work members, elements and the like have been accurately aligned. Drift pins shall be employed only to bring together parts for assembly and must not to be used to distort the work. Stanchion bases shall be levelled up by the use of laminated steel packs placed at the corners of the base plates. When the stanchion has been finally plumbed and levelled the space under the base plate shall be completely filled with cement grout. When this grout has hardened sufficiently the steel packings shall be removed by the specialist. Alternatively a centre plate packing 50 mm square may be provided and left in to aid the levelling operation.

8.24 BEDDING OF STEEL WORK

Bedding shall be carried out with portland cement grout, mortar or fine concrete. Grout shall be used for voids under 25 mm in thickness and it shall be just sufficiently fluid to flow and fill the voids completely.

For voids between 25 mm and 50 mm in thickness fluid Portland cement mortar of a strength not less than 1:2 shall be used. Fluidity shall be consistent with its ability to fill the voids completely. For voids in excess of 50mm thick semi-dry Portland cement mortar of a strength not less than 1:2 or fine concrete of a strength not less than 1:1:2 shall be thoroughly rammed into the voids until they are filled. Formwork shall be placed around the faces away from the end at which the ramming operations are being carried out in order to prevent the loss or lack of consolidation of the materials.

Before grouting the steelwork bases shall be supported by steel wedges and immediately prior to grouting the voids to be grouted shall wedges and immediately prior to grouting the voids to be grouted shall be thoroughly cleaned out. The operations shall not be carried out until the steelwork has been finally levelled and plumbed.

8.25 PARTICULAR REQUIREMENTS

8.25.1 Design Loads for Structural Steelwork

The Contractor shall design all steelwork to allow for a live load of 0.60 KN/m².

Allowance to be made for all ceilings which are suspended from the steel frame.

Design wind speed to be 120 km/hr.

All calculations and drawings to be submitted to the Engineer for approval.

It should be noted that the approval of the Engineer does not absolve the Contractor from his responsibility with respect to his calculations and to any dimensional errors.

FLOOR, WALL AND CEILING FINISHES

- 9.1 Cement
- 9.2 Water
- 9.3 Sand
- 9.4 Admixtures and plasticisers
- 9.5 Colour pigments
- 9.6 Plasterboard
- 9.7 tiles
- 9.8 Adhesives and sealants
- 9.9 Workmanship generally
- 9.10 Defective/damaged work
- 9.11 Storage
- 9.12 Preparation of surfaces
- 9.13 Plastering and rendering
- 9.14 Beds for floor tiling
- 9.15 Sand cement screed
- 9.16 Wall tiling
- 9.17 Floor tiling
- 9.18 Light glued floor coverings
- 9.19 Suspended ceiling
- 9.20 Roads and paving

9 FLOOR, WALL AND CEILING FINISHES

9.1 CEMENT

The cement shall be as described in 'Concrete work'.

9.2 WATER

All water used in the completion of the finishes as specified herein shall be clear, clean, potable, fresh water, free from all deleterious matter or chemical impurities which may adversely affect the finishes and shall comply with BS 3148.

9.3 SAND

The sand is to be clean, sharp, river sand free from earth, loam, saline materials or other impurities and well graded from coarse to fine.

For use in plastering, sand is to comply with the requirements of BS1198 Table 1.

For use in beds, granolithic finishings, tile bedding and jointing, etc., sand is to comply with the requirements of BS 1199 Table 1.

9.4 ADMIXTURES AND PLASTICISERS

All additives and the like shall only be used when approved in writing by the Engineer and in strict accordance with the manufacturer's written instructions.

9.5 COLOUR PIGMENTS

Colour pigments shall comply with the requirements of BS 1014, and are to be lime proof and non fading.

9.6 PLASTERBOARD

Plasterboard shall be self-finished gypsum wallboard, or gypsum lath or baseboard where to receive a skim coat, complying with requirements of BS 1230. (National Gypsum Company homepage: <http://www.nationalgypsum.com/>)

9.7 TILES

Unglazed ceramic floor tiles and coved skirting are to comply with the requirements of BS 1286.

The glazed ceramic wall and floor tiles are to comply with the requirements of BS 1281.

Glass mosaic tiles to be selected by Consultant.

Natural stone tiles to be selected by Consultant.

9.8 ADHESIVES AND SEALANTS

3-4mm high performance tropical grade thin flat bed water proof membrane adhesive by Feb, Bol or Fosrock or equivalent and approved - applied in accordance to manufacturer's written instructions. Specifically designed for the fixing of tiles in wet areas and provide a waterproof membrane to substrate.

9.9 WORKMANSHIP GENERALLY

Workmanship shall conform to the recommendations of the appropriate Codes of Practice. The Contractor is responsible for the provision of all labour, scaffolding, materials, tools, plant, etc., required for the completion of the execution of the Works, to the full satisfaction of the Engineer.

9.10 DEFECTIVE/DAMAGED WORK

All defective or damaged work shall be cut out and patched as directed by the Engineer. All patched surfaces shall match the consistency and finish of the original surface and shall be level with adjoining surfaces.

Damaged or deteriorated materials and manufactured items shall not be used in the Works. Any materials or manufactured items damaged during and after bedding or setting in position shall be removed and replaced by and at the Contractor's expense.

9.11 STORAGE

All branded materials delivered to site are to be properly stored in a watertight shed on a dry floor, or in equivalent conditions to avoid deterioration prior to use. Any materials which deteriorate or become damaged before use are to be removed from site and replaced at the Contractor's expense.

9.12 PREPARATION OF SURFACES

Surfaces to receive plastering, beds and the like are to be dry brushed to remove all loose particles, dust, laitance, efflorescence and the like, any projecting fins on concrete surfaces shall be hacked off. All traces of mould oil shall be removed from concrete surfaces by scrubbing with water containing detergents and rinsing with fresh water.

Surfaces are to be wetted and re-wetted as required to equalise suction before the first coat of plaster or the like is applied. Particularly dense, hard concrete surfaces are to be wetted and re-wetted as required before bonding plaster is applied.

Where surfaces are out of line, they are to be brought to level by hacking or dubbing out in similar mix to the undercoat prior to commencement of finishings. Irregularities in surfaces to be plastered shall be filled with mortar (without lime) twenty four hours before plastering commences.

Joints in blockwork and the like shall be well raked out before replastering to form a good key. Smooth concrete surfaces to be plastered shall be treated with an approved proprietary bonding agent.

Plastering shall not be commenced until all mechanical and electrical services, conduits, pipes and fixtures have been installed.

The Contractor shall satisfy himself as to the suitability of all surfaces prior to the commencement of the application of the finishing material.

9.13 PLASTERING AND RENDERING

Internal plastering is to comply with BS 5492.

The plaster for use internally is to be composed of one part cement, and four parts of sand, and is to be applied in two coats to a the finished stated thickness.

The render for use externally is to be composed of one part cement and four parts of sand, and is to be applied to the finished stated thickness externally.

Plaster or render is to be mixed in clean buckets and gauge boxes. All tools are to be kept clean and fresh plaster or render is not to be contaminated with set plaster or render.

The ingredients for the plaster or render are to be mixed three times dry and three times while water is added. Alternatively mixing may be done by approved mechanical mixers, which are to be cleaned before use.

The working time permissible after the addition of water to the plaster or render mix is to be thirty minutes. Mixed plaster or render that has exceeded this limit is to be removed from the site and not retempered and used in the works.

The Contractor is to ensure that before plastering or rendering commences the junctions between differing base materials are reinforced with a strip of galvanised expanding metal lath secured at both edges. All angle beads and the like shall also have been fixed.

All surfaces to be plastered or rendered are to be sprayed with water, with is to be allowed to dry out before a key coat of cement slurry is applied.

All undercoats are to be scratched to form an adequate key for the next coat. The setting coat is not to be applied until the floating coat has been left in a moist condition for at least three days.

All Plastering shall be executed in a neat workmanlike manner and made good to wood frames, skirting, pipes, fittings and the like.

Plasterwork is to be finished with a smooth, trowelled face, free from blemishes and fit to receive decoration. Render is to be finished with a wood float. Any blown, cracked or otherwise damaged plaster or render shall be condemned by the Engineer and is to be hacked off and made good with quick setting plaster at the Contractor's expense.

Full use is to be made of grounds, rules and angle trowels to ensure that all wall faces finish plane and true to line in all direction and that all angles are straight, true and plumb. Prices for plastering and rendering are to ensure that work to walls and ceilings are effectively 'cut' at the joint so as to minimise damage due to movement.

9.14 BEDS FOR FLOOR TILING

Beds for floor tiling shall be composed of 1 part cement and 4 parts of sand by volume. Mixing, all as previously described.

Prices shall include surface preparation, temporary rules, laying to falls and cross falls as required by the room location, making good and the like.

9.15 SAND CEMENT SCREED

Floor screeds are to compose of one part cement and three parts sand and are to be smooth and level. Final difference in levels in any part of the building shall not exceed 2 mm, otherwise the Contractor shall be required to apply an approved self levelling screed to finish the surface.

Where beds are to be laid direct on to a concrete sub-floor that has set, the surface of the sub-floor is to be thoroughly cleaned and prepared to ensure a good bond, the surface being chipped with a pick if necessary, brushed well and washed out to remove all dust and dirt, and thoroughly soaked with water left on overnight. Surplus water is to be mopped up and immediately prior to laying the bed, the sub-floor is to be coated with a grout of neat cement wash well brushed on as the work proceeds. The grout must not be permitted to set before the bed is laid.

Alternatively the Contractor may use a bonding agent applied in conformity with the manufacturer's instructions.

Pipes, conduits and the like to be embedded in a screed or topping shall be securely fastened to the concrete subbase, then apply cement and sand haunch to the side of pipes/conduits and a layer of chicken wire mesh overlaid at least 200 mm wide at each side. When these operations have been completed the Contractor may commence the laying of screed/toppings.

The Contractor shall lay screeds or toppings in bay sizes as instructed by the Engineer including filling joints between bays as directed. Joints in the concrete subbase shall be continued through the screeds or toppings.

The screeds or toppings shall be finished to give the surface stated using either a hand trowel, mechanical power float or the like. All finishes shall be uniform, smooth and free from ridges, trowel marks and other blemishes. For a non-slip finish apply carborundum particles between successive trowelling operations to give a smooth surface.

The beds shall be protected from excessively rapid drying out by means of tarpaulins or polythene sheeting for a minimum of 7 days after laying.

Laying beds is preferably to be carried out when the building is fully protected from adverse weather, however, the Contractor is to protect all beds as necessary from damage by wet weather.

9.16 WALL TILING

Glazed ceramic wall tiles shall comply with the requirements of BS1281.

The surfaces to which tiles are to be fixed are to be thoroughly dry before fixing commences and free from all defects. Any such defects are to be made good before work commences. Wall tiling shall be carried out in accordance with CP 212.

Tiles that are to be fixed to wall surface by bedding in an approved adhesive, extreme care being taken in the setting out, lining and levelling of tiles. All external angles are to be mitre jointed or rounded edged tiles as the location dictates. The adhesive is to be applied strictly in accordance with the manufacturer's instructions. The surface of the backing shall be scratched in an approved manner, when completely set, to form a key.

The agreement of the Engineer to the setting out of tiles is to be obtained before commencing work and a sample room is to be set out for the Engineer's approval prior to continuing work on other rooms.

Shop drawings shall be prepared where patterns in the wall tiling are required.

Tiles shall be fixed with true horizontal and vertical joints of an even width of 1-2 mm to a true vertical plane.

Tiles adhesive shall be approved in writing by the Engineer prior to the commencement of this work.

Adequate time shall be allowed to enable complete setting of the tile bedding before joints are grouted. Grout of a plastic mix of neat cement, colour to Engineer's selection, shall be used in grouting up the joints. The whole of the tiled surface is to be thoroughly cleaned down on completion and left in perfect condition.

Any cut tiles are to be neatly and cleanly cut using an approved method and cut tiles are to be used only at internal corners or in other locations to be approved by the Engineer. All service points in wall tiling shall be of drilled holes if the tiles in which they are located are central to the tile.

9.17 FLOOR TILING

Prior to commencing the floor tiling the Contractor shall satisfy himself that the surface on which the tiles are to be laid is satisfactory to receive the tiles. It is the responsibility of the Contractor to provide a satisfactory surface and or bedding and any remedial work necessary is to be carried out at the Contractor's expense.

Before laying commences the base is to be free from dust, loose material, grease, plaster, and the like.

Care is to be taken in cutting and fitting and the setting out of tiles and colour patterns are to be as shown on the drawings or as directed by the Engineer. Shop drawings are required where patterns in the floor tiling are required. Any adhesive on tile surface or

any other finished surface is to be completely cleaned off, The tiles shall be laid with true aligned joints of an even width of 1-2 mm and grouted up on completion.

The work shall be set out from the centre of rooms using whole tiles and working outwards. Rates are to include for the all cut margins and make up pieces at limits and boundaries.

The flatness of tiled or paved floors must be such that a two meter rule moved in all directions shows no bump or hollow of over 4 mm.

The Contractor is to store floor tiles in such a way that they are protected from moisture until laying. Ceramic floor tiles shall be laid in a manner as previously described in this section onto a cement and sand bed, with even joints of not wider than 2mm. Care being taken to adequately fill and remove all air pockets from beneath the tiles. The tiles are to be grouted with a tinted mortar mix to match the tiles, a minimum of twelve hours after completion of the tiling.

All floor tiling in wet area such as bathrooms, toilets, kitchen, washing area, balconies, mechanical rooms and the like above ground floor level shall be laid over a waterproof membrane on a sub base. Provide continuous skirting up walls. Floor tiling shall be laid to falls towards drainage outlet of respective rooms.

Protect floor tiling with slurry or like material on completion and clean off and prepare flooring to satisfaction of Engineer.

9.18 LIGHT GLUED FLOOR COVERINGS

9.18.1 Surface Preparation

The light glued floor coverings shall be laid on a screed to the thickness shown on the drawings. All screed materials shall conform to the requirements of previous clauses of this section. The screed thickness shall include taking out all irregularities in the floor slab and be finished true and level so that a 2 metre ruler laid on the floor shows no dip or bump of more than 3 mm. Prior to the installation of the floor covering a levelling screed shall be laid to ensure a perfectly smooth surface. The product shall be selected from a range that is compatible with the adhesive to be used. Products with a caseine or plaster base shall not be used.

9.18.2 Laying of Timber Strip Flooring

This work shall not commence until the levelness and surface of the levelling screed is approved in writing by the Engineer. Further preparatory work shall be at the Contractor's expense.

The adhesive used shall be that as specified by the tile/sheet manufacturer and applied in accordance with the written instructions. All surfaces to receive adhesive shall be clean and free from dirt to avoid poor adhesion and unevenness of finished surface. The flooring shall be laid by double gluing unless otherwise stated in the technical instructions. All joints shall be welded perfectly in line and all cutting and fitting at corners, junctions and the like shall be carried out in a workmanlike manner. Skirting tiles shall be fixed as detailed to room perimeters ensuring a neat joint at the junction with the flooring. Excess adhesive shall be carefully removed to ensure no damage to the flooring.

All sections of the flooring that show poor adhesion, swelling, bumps and hollows greater than approved by the Engineer, inaccurate joint alignment, open joints, poor workmanship, cutting and the like shall be removed and redone at the Contractor's expense.

9.18.3 Laying of Textile Flooring

The surface shall be prepared as for the plastic flooring and these works shall be carried out in accordance with BS 5325 by experienced operatives. This work shall not commence until the building is watertight and all wet trades including painting and the mechanical and electrical works are completed.

9.19 SUSPENDED CEILINGS

9.19.1 General

The Contractor shall be responsible for the co-ordination of the service and suspended ceilings, including checking the ceiling heights and setting to module, which shall be to the exact locations required by the Engineer, who shall confirm and approve the setting out and location of all fittings, luminaires, switches, smoke detectors, security alarms and detectors, air conditioning grilles and controls and the like. Ceilings shall be installed by specialists. They shall be capable of outstanding normal air pressure and suction forces action both below the ceiling and within the ceiling void.

The Contractor shall prepare, and submit for approval, fully dimensioned working drawing prepared from the general working drawings of the Engineer and from a site survey. These drawing shall coordinate the service and ceiling installation. Setting out points common to all trades including service shall be established early in the manner described and shown on the working drawings.

Under no circumstances shall work of other sections be concealed by ceilings until same has been inspected and approved by the Engineer.

Finished ceiling heights shall be rigorously respected; they shall be measured from the finished floor levels.

The ceilings shall be left perfectly flat and shall not show a deviation of more than 3 mm from a 3 metre straight edge. The Contractor shall take all possible precautions to eliminate any defects.

Price shall include for cutting and fitting ceilings around obstacles and neatly finishing the edges of the work.

Proprietary suspended ceiling system shall be installed in strict accordance with the manufacturer's instructions, by workmen skilled in this work in a rigid and secure manner so that the final surface is free of any waves, buckles or sap.

Tiles and ceiling forming a grid or pattern shall be set out on the axis of the room in both directions.

Suspended ceilings shall not be erected until the windows have been glazed, the building closed in, the plasterwork dried out, all wet work completed and the building suitably air conditioned; relative humidity must not exceed 70% and the temperature must be maintained within the range 15-30°C.

The design of and dimensional tolerances set by the manufacturer for accessory items such as formed wire hangers, spring spacer clips, tile retainers, and spacer bars shall be such as to assure satisfactory performance of their intended function in the suspension system. Failure attributable to such accessories to control alignment, prevent undesirable rotation or other unsatisfactory performance which results in unfavourable appearance will be cause for their rejection.

General installation procedures shall be as follows:

- ◆ the area to receive treatment shall be dry and be satisfactorily closed against excessive traffic and be protected against weather before work is started.
- ◆ Installation shall be in strict accordance with manufacturer's specifications except as modified by this Specification.
- ◆ Install units in a true and even plane, in straight line course laid out symmetrically about centre lines of ceiling or panel, continuing pattern, through wall openings or as indicated. Border tile shall not be less than 15 cm wide.
- ◆ Fit border units neatly against vertical surfaces.
- ◆ Seal joints in units around pipes, ducts, and electrical outlets with acoustical sealant.
- ◆ Carefully coordinate and fit units to grilles, lighting fixtures and other related items of work. In determining spacing and locations of hangers for main runners and carrying channels, take into consideration the weight of grilles, fixtures, etc. that are to be installed in conjunction with acoustic ceilings.

9.20 ROADS AND PAVING

9.20.1 Materials

Interlocking paving tiles shall be as manufactured by Pasco or equal and approved, 60 mm thick for walkways and 80 mm thick for driveway and parking areas, colour, pattern and type to be approved by Engineer.

The sand used in this work shall be obtained from approved sources and shall comply with the requirements of BS 882 Zone II.

9.20.2 Construction

Tiles shall be laid on a 40 mm thick black sand bed. On completion all joints are to be filled with sand. The underlying sub-base course thickness shall be as described and be imported material compacted to 95% maximum dry density and attaining a CBR value of more than 60. The sub-grade shall be well compacted and shall attain a CBR value of more than 25.

9.20.3 Kerbstones

Precast concrete kerbstones shall comply to BS 340, Figure 6 for use in roads and paving. The kerbstones shall bedded and haunched on mass concrete using sulphate resisting cement.

PAINTING & DECORATION

- 10.1 General
- 10.2 Materials
- 10.3 Workmanship

10 PAINTING AND DECORATING

10.1 GENERAL

The painting materials shall be obtained from an approved manufacturer and shall be supplied ready mixed in the manufacturer's sealed and branded containers. Each container shall bear the maker's brand name, identification of contents and directions for its proper use. All material must be thoroughly stirred before use.

All sealers, primers, undercoats and thinners shall be the products recommended by the manufacturers of paint used for the finishing coat.

Unless otherwise indicated on the Drawings colours shall be selected by the Architect.

10.2 MATERIALS

10.2.1 Rust Inhibitors

Rust inhibitors shall be of approved manufacture.

10.2.2 Knotting

Knotting shall comply with BS 1336.

10.2.3 Stopping

Stopping for woodwork to receive clear finish shall be tinted to match surrounding woodwork, to approval.

Stopping for internal woodwork, plywood, hardboard, and fibreboard shall be linseed oil putty to BS 544. tinted to match the colour of the undercoat.

Stopping for external woodwork shall be white lead paste and gold size well mixed.

10.2.4 Thinners

Thinners shall be approved turpentine or white spirit to B.S. 245.

10.2.5 Stain

Stain for woodwork shall be an approved brand of oil stain complying with B.S. 1215.

10.2.6 Polyurethane Lacquer

Polyurethane lacquer for woodwork shall be of an approved manufacture.

10.2.7 Varnish

Varnish for interior woodwork shall be an approved brand, oil varnish. Varnish shall form a hard flexible transparent and quick drying film.

10.2.8 Linseed Oil

Linseed oil for woodwork shall be refined linseed oil to comply with B.S 246.

10.2.9 Priming Paints

Priming paints shall be the primer recommended by the manufacturer of the finishing paint or:

- ◆ For woodwork -lead-based or priming paint to comply with B.S 2521 and 2523.
- ◆ For steel work-red oxide priming paint to comply with B.S 2524.
- ◆ For galvanized, zinc or aluminium work- grey zinc chromate priming paint.

- ◆ For concrete, blockwork, plaster, plasterboard and the like- alkali priming paint.

10.2.10 Undercoating

Undercoating shall be:

- ◆ Zinc oxide based undercoating paint.
- ◆ White lead based undercoating paint in accordance with B.S 2525-7. Colours shall approximately match the finishing paint.
- ◆ Synthetic alkyd based undercoating in accordance with the recommendations of the paint manufacturer.

10.2.11 Finishing Paints

Finishing paints shall be as otherwise specified.

10.3 WORKMANSHIP

10.3.1 General

The Contractor shall carry out all tests necessary for determining the colours and shades of the finishes and the appropriate methods of application. Sample panels shall be completed in accordance with Architect's instructions.

All work shall be performed in accordance with the manufacturer's written instructions.

Before application of any paint or finish all surfaces shall be cleaned, dried and prepared as specified hereinafter, all to the Architect's approval, no work shall commence until this approval is given in writing to the Contractor.

The Contractor shall coordinate work to ensure that factory primed items are primed or painted as required in the Specifications.

All metal fittings such as hardware and fastenings, etc., not required to be painted shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed the fitting shall be cleaned and refixed in position.

Before painting floors must be washed and every possible precaution shall be taken to keep down dust before and during the painting processes. No paint shall be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation, efflorescence, etc., before the application of each coat.

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain, extreme humidity, dust storms, high temperature of surface etc.

All coats of paint must be thoroughly dry before subsequent coats are applied, and rubbed down with fine waterproof abrasive where necessary.

All coating shall be well applied, leaving no sags, laps, brushes or other defects. Each coat must thoroughly dry before next coat is applied. All work must be carefully cut into a true line and left smooth and clean.

Details of mixing and application shall be in accordance with the Specifications of the manufacturer concerned and to the approval of the Architect. The mixing of paint, etc., of different brands before or during application will not be permitted. No dilution of painting materials shall be allowed except strictly as detailed by the manufacturers and as approved by the Architect.

On surfaces which are not accessible to paint brushes or rollers paint shall be applied by spraying or with sheep skin daubers. All surfaces to be painted shall be thoroughly covered with paint. Method of paint applications shall be approved by the Architect prior to the commencement of the work.

Brushes, pails, kettles and all other tools and equipment used in carrying out the work shall be maintained in good working order, and shall be clean and free from foreign matter. They shall be thoroughly cleaned before being used for different types or classes of materials.

The Contractor will be required to repaint, at his own expense any work on which the paint is found to be incorrectly applied. The Contractor shall be responsible for protecting from damage the paint work and all other work during and after

operations including the provision of all necessary dust sheets, covers, etc. All paints dropping shall be cleaned up as the work proceeds.

All loose and defective paint shall be removed from previously painted surfaces before re-painting. All burning off must be done by skilled workmen. The blow-lamp must not be used on surfaces adjoining glass. Damage to adjacent surfaces shall be made good at the Contactor's expense.

Prior to hand over the Contractor shall carry out all remedial painting work due to damage caused by others, adjustment and easing of joinery and metal work testing and commissioning of service installations and the like all as instructed by the Architect. On completion, leave Works clean and tidy to the Architect's approval.

10.3.2 Painting to Concrete, Block or Plaster

Concrete, blockwork and plaster surfaces to be painted or decorated shall have all cracks cut out and made good to the satisfaction of the Architect.

Plasterboard surfaces shall have taped joints and the surface puttied to the satisfaction of the Architect. The surfaces shall be completely dry and shall be brushed free of impurities immediately prior to the commencement of the painting work.

Efflorescence shall be completely removed by rubbing down with dry coarse cloths followed by wiping down with damp cloths and allowed to dry. All surfaces shall be rubbed down with fine glass paper and brushed free of dust before applying any form of decoration.

Concrete blockwork and plastered surfaces which are to receive paint shall be given one thin coat of oil putty and allowed to dry for at least two days. The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set shall be rubbed down again with fine glass paper before applying the painting system.

Emulsion paint shall be applied by brush or roller and shall consist of primer and two full coats of paint.

Texture paint shall be uniformly applied at a rate of not less than 4m² per litre by overlapping, crisscross rollers or spray in accordance with the manufacturer's instructions. Where finished surfaces are described as having smooth texture finish, the overall thickness of the applied finish shall be less than 1.5 mm. Where finished surfaces are described as having rough texture finish, the overall thickness of the applied finish shall be not less than 2 mm. Finished surface shall be uniform in sheen colour and texture, free from runs, sags, crawls or other defects.

Oil paint shall be applied by brush or roller and shall consist of a priming coat, two undercoats and one finishing coat of paint.

Fire resistant paint shall be applied in three coats over a primer all in strict accordance with the manufacturer's instructions.

10.3.3 Lacquer to Woodwork

Woodwork to lacquered shall be cleaned of impurities.

Knots shall be treated with two coats of knotting.

Where shown on the Drawings or required by the Architect the wood shall be stained with a water or spirit stain to the approval of the Architect.

The coats of lacquer shall be applied on joinery by brush or spray, either in the joinery shop or on Site as directed by the Architect.

10.3.4 Oil Stain Finish to Woodwork

The stain finish to woodwork shall be an approved manufacturer's oil stain system applied strictly in accordance with the manufacturer's instructions.

All surfaces are to be thoroughly dry and cleaned and sanded down and all nail holes or similar defects shall be filled and levelled up with approved stopping.

The finish shall be applied in two coats. The first coat shall be pigmented stain wax brush applied. The surface shall be allowed to dry for 2 -10 minutes and then rubbed with a cloth in a rotary motion to remove excess stain and produce an even surface.

The first coat shall be allowed to dry completely before application of the second coat.

The second coat shall be natural (clear) stain wax, buffed.

The Architect shall select the stain colour and the Contractor shall allow for preparing sample panels for approval and these sample panels will provide the standard for the work.

10.3.5 Varnishing

All surfaces to be varnished shall be thoroughly dry and cleaned and sanded down and all nail holes or similar defects shall be filled and levelled up with approved hard stopping. Sanding shall follow the line of the grain. Knots shall be treated with two coats of knotting.

Two or three coats of clear varnish shall be applied as recommended by the manufacturer of the varnish or as directed by the Architect.

10.3.6 Painting to Woodwork

Woodwork to be painted shall be cleaned of impurities.

Knots shall be treated with two coats of knotting.

Priming paint shall be applied by brush. Two coats shall be applied to end grain. Priming paint shall be applied on Site after the Architect has approved the joinery and before it is fixed.

When the priming paint is dry, all cracks, holes, open joints and the like shall be filled with stopping and rubbed down with fine flass paper.

Two undercoats and one finishing coat of paint shall be applied by brush.

The priming paint and undercoats shall be lightly rubbed down with glass paper to remove blemishes, and all dust removed before the application of subsequent coats.

10.3.7 Painting to Metalwork

Steelwork delivered to the 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 metalwork 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.

Metal which is 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.

HYDRAULICS AND DRAINAGE

- 11.1 Plumbing
- 11.2 Work in Common Piping
- 11.3 Water Supply Work
- 11.4 Drainage Work
- 11.5 Sewer Mains
- 11.6 PVC Pipes
- 11.7 Support for UPVC Pipes
- 11.8 Valves and Fittings
- 11.9 Fitting and Fixture Quality
- 11.10 Manholes and Manhole Covers and Frames
- 11.11 Fixtures and Accessories
- 11.12 As Built Drawings
- 11.13 Miscellaneous

11 HYDRAULICS AND DRAINAGE

11.1 PLUMBING

11.1.1 General

The materials used and workmanship shall be of highest quality and grade unless otherwise specified shall conform to the latest specifications of British standards and codes of practice “ water supply “sanitary. Pipe work “building drainage “ surface water and sub- soil drainage” and applicable to details and work indicated on the drawing and bill of quantities. In case of any discrepancy / ambiguity the decision of the Consultants shall be final, and the Contractor will act and perform accordingly.

The work shall be executed strictly in accordance with the rules and regulations set by the relevant Local Authority of the Maldives.

The Contractor shall be responsible for obtaining the necessary approvals and test certificates from the concerned departments of Maldives.

Plumbing work shall be carried out by licensed plumbers and shall produce the copy of the license before executing the work, to be approved by the Consultant.

Any damage done by the Contractor to any existing work during the course of execution of his work, shall be made good by him at his own cost. Failing which it shall be get done by the Consultants at Contractor's risk and cost.

The Contractor shall be responsible to connect the drainage pipe to the mains and to obtain the necessary approvals and certificates from the relevant authorities of the Maldives.

All connections to mains and meter installation shall be arranged by the Contractor and payment of fees thereof, if any, shall also be made by the Contractor.

The Contractor shall be responsible for the watch and ward of all fittings until the works is fully completed and handed over to the owner.

The levels, measurements and other information concerning the existing site as shown on the drawings or as described are supposed to be correct. The Contractor shall, however, verify them by himself and no extra claim whatsoever shall be entertained on account of the errors or omissions in such matters or on account of the descriptions turning out to be different from what was expected.

The Consultant shall instruct the Contractor to purchase and use such materials of particular make or from particular source as may in his opinion be necessary for proper and reasonable compliance with the specification and execution of the works.

After all plumbing fixtures and equipment have been set ready for use, and before the Contractor leaves the job, he shall thoroughly clean all fixtures installed by him, removing all plaster, stickers, rust stains and other

foreign matter of discolouration on fixtures, leaving every part in acceptable condition and ready for use to the satisfaction of the Consultants.

11.1.2 Drawings and Information Required

The Contractor shall submit shop drawing for the entire installation including installation details for all items required or asked for approval of the Consultant.

Approved by the Consultant of shop drawing for any material, apparatus, devices and layout, shall not relieve the Contractor from the responsibility of furnishing same of proper dimension, size, quantity and all performance characteristic to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve the Contractor from responsibility for errors of any sort in the shop drawing.

If the shop drawings deviate from the contract documents the Contractor shall advise the Consultants of the deviations in writing accompanying the shop drawings including the reasons for the deviations. At the start of the project the Contractor shall periodically and thereafter submit to the Consultants list of all shop drawings which will be submitted in the course of the project. The list shall show the disposition of each item including date of submission and approval etc. The list shall be kept up to date through the entire course of construction.

11.1.3 Record Drawing

During construction the Contractor shall keep an accurate record of all deviations between the work as shown on the contract drawings and that which is actually installed.

The Contractor shall secure from the Consultants after approval of his shop drawing a complete set of drawing and note changes thereon in ink.

The Contractor shall make a complete record of all changes and revisions in the original design which exist in the completed work.

The cost of furnishing above prints and preparing these for record " shall be deemed to be include in the tendered cost and its effects spread over other items of work, and as such item shall not be a subject to payment". When all revisions showing the work is finally installed the corrected Original Transparencies shall be submitted to the Consultants before final payment for the completed work will be made.

11.1.4 Operating and Maintenance Instructions

Three sets of operating and maintenance instruction covering completely the operation and maintenance of all plumbing equipment, controls, heaters, pumps and the like shall be furnished to the owner, by the Contractor.

11.1.5 Tests

The entire system of drains, waste and vent piping inside and outside the building shall be tested by the Contractor under a water test, which shall include the entire system from the lowest point to the highest pipes above the roof.

The water test shall be made in accordance with all local requirements. Every portion of the system shall be tested to a hydrostatic pressure equivalent to latest 15 feet head of water. After filling, the Contractor shall shut off water supply and shall allow it to stand 2 hours under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for device, material supplies, labour and power require for all tests. All tests shall be made in the presence and to the satisfaction of Consultant.

Defects disclosed by the test shall be repaired or if required by the Consultant defective work shall be replaced with new work without any extra charge to the owner. Test shall be operated as directed until the work is proved satisfactory.

Fixture shall be tested for soundness, stability of support and satisfactory operation.

The Contractor shall notify the Consultant at least one week in advance of making the required test, so that arrangements may be made for their presence to witness the test.

Equipment shall be tested in service and the Contractor shall demonstrate that the equipment performs the work intended for it and that it complies with the requirement of these specifications for such equipment, to the satisfaction of Consultants.

The rates shall include for all costs associated with tests.

Timely notice shall be given by the Contractor to the Consultant of the hour of tests.

11.2 WORK IN COMMON PIPING

11.2.1 Material

Piping and fitting material shall be U.P.V.C, Hard Impact U.P.V.C. or High Temperature U.P.V.C. and approved by the Consultant.

Piping material shall comply with requirements of Maldives Water Supply and Sewerage Authority and other relevant authorities and Consultants.

Materials for the piping and service requirements shall basically conform to the service pressures encountered.

11.2.2 Providing Drawings and Manuals

The Contractor shall submit one set of originals and further two copies of layout drawings to the Consultant after completion of the Works. These drawings must give the following information:

- (a) Run of all piping and diameter on all floors and the vertical stacks.
- (b) Location and sizes of all control valves, access panels and other equipment.
- (c) IL of all manholes including IL at our files.

The Consultant shall issue the Certificate of Completion only after the submission of the As Built Drawings by the Contractor.

The Contractor shall submit to the Consultant for approval, samples, shop drawings, manufacturer's drawings, equipment characteristics and capacity data etc. of all equipment, accessories devices etc. that he proposes to use in the installation.

11.2.3 Samples

The Contractor shall provide samples of all sanitary fittings, pipes and specials, man-hole cover and frames, gratings and water supply pipes and fittings etc., and shall be deposited with the Consultant (which will be returned to the Contractor at the completion of the Works) and shall obtain approval from the Consultant before using in the Works. Any material rejected by the Consultant shall be removed from the site within 24 hours of rejection.

11.2.4 Drawings

The works shall be done in conformity with the plans and within the requirements of the general Architectural, electrical and structural plans. This work shall be properly coordinated with the work of the other trades. Hangers and sleeves shall be furnished in time for their installation as other work proceeds.

The plumbing drawings are diagrammatic, but shall be followed as closely as actual construction and work permits. All deviations from drawings required to conform to the building construction shall be made by the Contractor at his own expense.

The Architectural drawings shall take precedence over the plumbing drawings as to all dimensions.

Large size details shall take precedence over small size drawings. The special dimensions in the specifications or schedule of quantities or instructions of the Consultant shall supersede the drawings. The Contractor shall verify all dimensions at site.

The recommend position of the fittings, fixtures, control valves, tanks etc. as shown on the drawings will be adhered to as far as practicable.

Should there be any discrepancy due to incomplete description ambiguity or omission in the drawings and other documents, whether original or supplementary, forming the contract, either found on completion or during the course of the installations work, the Contractor shall immediately, on discovering the same, draw the attention of the Consultants and the Consultants decision is final and binding on the Contractor.

11.2.5 Existing pipes

The site shall be examined for field drains and those, when found, shall be either entirely removed or diverted, trenches filled with dry earth in 200mm to 300mm layers and consolidated as directed by the Consultant.

11.2.6 Spare Parts

Necessary spare parts of the plumbing equipment for the one (1) year operation shall be supplied by the Contractor.

11.2.7 Excavation

All excavations shall be steel/timber to the satisfaction of the Consultant and the type of steel/timber shall be suitable to the kind of earth encountered. Fixing of timber and removal after completion of work shall be done as directed by the Consultant.

Should any water accumulated in the trenches, headings or other excavation, the Contractor shall do such work as may be necessary to drain away the accumulated water and shall install pumps as may be required to keep the excavation and trenches dry. The Contractor shall ensure that the flow water in trenches or excavation does not injure or remove cement or aggregate of any concrete that has not set. No subsoil water shall be discharged into open drains or sewer at the site.

In refilling trenches after excavation this should be done in layers of 150mm after consolidating each layer. Special care shall be to see that the earth is packed uniformly and no injury to the pipe.

Rates for excavation should include for backfilling in consolidated layers where necessary and as directed by the Consultant.

11.2.8 Piping

The Contractor shall, as soon as possible after the award of the contract, prepare and submit to the Consultant for approval, working drawings showing exact locations and pipe runs for all pipework, the layout and setting up of equipment and the connection of piping to the equipment. Such drawings shall include details and methods of supports, anchors and sleeves etc.

Pipe runs shown in the drawings are approximate and intended to indicate the general run and locations only. The exact locations of all pipework shall be determined on Site.

All pipes, fittings etc. shall be kept closed against moisture and foreign matters when stored at site and during installation.

All pipes shall be fixed clear of one another and be so arranged as to provide easy access for maintenance and repair.

All plumbing work shall be carried out by qualified plumbers in accordance with the British Code of Practice and Regulations and requirements of related Authorities.

Materials for the piping and service requirements shall basically conform to the service pressures encountered.

Each part of the installation of the plumbing work shall be completed in all details as shown in the drawings or as specified and provided with all necessary control valves, etc. that will be necessary for their satisfactory operation.

All piping shall be run plumb, and straight and parallel to walls, except drain line which shall pitch 6mm per 300mm in the direction of flow or as per the Consultants instruction.

Pockets, unnecessary traps, turns and off-sets shall be avoided. When traps or pockets are unavoidable they shall be valved drains.

Piping installed on the concrete slab shall be firmly fixed or anchored to the floor with packing to prevent damage to pipes. Pipes shall not be bent with bender where cross with other pipe or change to upward.

Where pipes are to be laid directly in the ground, bed shall be sufficiently compacted, necessary protection for piping shall be taken.

Backfill shall be done after the approval of the Consultant in such a manner not to damage the pipe line and shall be restored to the original stage.

Where pipes penetrate through waterproof part or fire partition or fire wall, pipe sleeves shall be provided and clearance between pipe sleeve and pipe shall be filled with caulking material approved by the Consultant.

Pipes, fittings, valves and accessories shall be thoroughly cleaned, both internally and externally before installation and shall be cleaned before putting into service.

Plumbing work shall be completed in accordance with the details shown on the Drawings or as specified and provided with all necessary control valves, etc. that will be necessary for their satisfactory operation.

All pipes shall be cut square and true to the pipe axis by means of suitable tools without reducing pipe diameter and cut ends shall be finished smooth. Before making connections, chips, dirt and other foreign matter shall be removed from inside interior of each pipe. Fixing of hangars and embedding of pipe sleeves shall be carried out without delay along with the progress of the work where required.

Pipe connections for the water supply system shall be by union type for pipes of 50mm diameter and less and for pipework above 50mm diameter, connections shall be made by means of appropriate socket fitting etc. Jointing shall be generally by means of solvent cement according to manufacturer's instructions

Vertical pipe shall be braced at more than 2 point in every storey.

11.3 WATER SUPPLY WORK

11.3.1 Materials

Pipes, joints and fittings for water supply work shall be high pressure U.P.V.C. Materials and workmanship shall comply with the local water supply authority requirements.

11.3.2 Water pump

Fresh water pump system, and well water pump shall be supplied & installed by the Contractor. All the pump specialisation shall be submitted to the Consultant for approval

11.3.3 Spacing of supports

Support spacing for P.V.C pipes shall be as follows:

Nominal Diameter	Up to 40	More than 50
Space (m)	1.2	1.5

11.4 DRAINAGE WORK

11.4.1 General

High Pressure P.V.C pipe and fittings shall be used for all drainage work including vent pipes.

Joints shall be made by the cold-jointing method, and the pipe interior shall have not offset at the joint interfering with the flow. Joint adhesive shall be good quality and shall not be affected by heat and shock.

Where horizontal drain branch joints the main, such branch shall be connected to the main in a substantially horizontal position and at an acute angle of not more than 45 degree to the main in all cases.

11.4.2 Vent stack pipes

Vent pipe shall be vertically branched out upward from a horizontal drain branch pipe or other appropriate point. Horizontal branching of the vent pipe shall be done on approval of the Consultant.

Where vent pipes on each floor are to be connected to the vent stack, all connections shall be made at least 400mm above the respective overflow edges of fixture on that floor.

The provision of the preceding item shall also apply to the connection of vent stack vent pipe.

Vent stack shall be connected to the waste stack or soil stack at the lowest part to stack pipe.

Where vent pipe is to be connected to the horizontal drainpipe, such angle shall be more than 45 degree to upward.

Vent stack shall be extended 600 mm from the top of the roof or parapet and top of pipe shall be covered with vent cap.

11.4.3 Spacing of support

Spacing for support shall conform to the section of water supply work item of spacing.

11.4.4 Laying of pipes

The pipes shall be laid to proper lines and levels as shown in the plans and directed by the Consultant, as the main is laid, the front pipes in the trench shall always be closed with a plug either of iron or wood and security fastened. The plug shall not be removed except when pipe laying is resumed or for purposes of testing.

11.5 SEWER MAINS

All mains shall be laid on a good solid, bottom to prevent subsidence and consequent fracture. Mains running under buildings, if unavoidable, shall be completely surrounded by 150mm of concrete. In case of mains passing through a well, the weight of the latter shall be carried by a lintel or a suitable relieving arches. All rising mains shall be properly plugged to all wall brackets at regular intervals as given in the drawings. All mains shall be concealed inside wall as far as possible except for vertical sewer mains, cleaning doors shall be provided in the walls whenever necessary and as directed by the Consultant.

After the cement has had time to set, the pipes shall be tested in length between manholes in the following manner.

In the lowest manhole/intercepting trap as the case may be, a plug shall be inserted in the pipe. The disc in the pipe at the upper manhole shall be fitted with a filling pipe with a right angle bend and an air cock. The pipeline shall then be filled with water by means of the pipe connection on the upper disc. The air cock on the upper disc shall be kept open while the pipeline is being filled to permit the escape of air. When the pipes are filled with water and air excluded, the air cock shall be shut and the water shall be poured into conical filler, attached to the filling pipe until the water remains in the filter. The filling pipe shall then be raised and fastened so that the height of surface of the water in the filler above the invert of the pipe is 1828 mm which will be usual test pressure for s.w pipes. If the water level does not fall more than 16mm (12mm) in a length of 91.4 metre the test may be considered satisfactory. The Contractor shall good all defective work at his own expense.

11.6 P.V.C PIPES

Manufacturer's instruction should be followed, pipes to be used for water mains shall where specified have integral rubber ring joints when solvent cement joints are specified, a sufficient number of expansion/contraction joints shall be incorporated in the length of mains to allow for variation of temperature to the recommendation of the pipe manufacturers.

These pipes shall be effectively protected from the direct rays of sun immediately after they are laid and until permission is given for the trenches to be refilled by the Consultant. Subject to such permission being obtained, trenches shall be refilled without delay. Final connection at a fixed point shall be deemed unto the majority of the length of the pipe line has been covered by backfill in order to reduce the effect of expansion and contraction caused by temperature variations.

11.7 SUPPORT FOR U.P.V.C PIPES

When U.P.V.C pipelines incorporate metal valves or other heavy fittings, it is essential to support the valves directly rather than allowing their weight to be carried by the U.P.V.C. pipe and support shall be placed on either side of the fittings mentioned above. Moulded plastic fitting also should be supported.

Maximum allowable horizontal support distance for U.P.V.C. pipes are given below.

Nominal before	12 mm (1/2")	18 mm (3/8")	25 mm (1")	32 mm (1¼")	38 mm (1½")	50 mm (2")	75 mm (3")	100 mm (4")
Support distance	533 mm (1'9")	616 mm (2'0")	686 mm (2'3")	764m m (2'6")	840 mm (2'9")	915 mm (3'0")	1220 mm (4'0")	1290 mm (4'6")

For vertical installation supports, distances shall be doubled.

11.8 VALVES AND FITTINGS

11.8.1 Sewer Pipe Fittings

All 'P', 'S', 'I' junctions bends etc. required shall be furnished and set without extra charge and shall confirm to the pipe specifications as to quality.

11.8.2 Air Valves

These valves to be fitted as per drawings and Bill of Quantities shall be tested and accompanied by a certificate of efficiency. The floating ball in the valve shall be suitable metal or vulcanite or rubber specially manufactured for tropical conditions.

11.8.3 Scour Washout Valve

These shall be provided at portions shown in place and shall contain in one unit a flanged scour valve with short connection pieces, cast iron bend and T pieces for connection to main pipe. The rate shall also provide for short length of straight pipe to a convenient as per details complete with covers and surface boxes.

11.8.4 Foot Valves And Strainers

Foot valve and strainers should be of reputable manufacture approved by the Consultant and shall be fitted with flushing lever attachment where specified.

11.8.5 Pressure Reducers

Pressure reducing valves shall be of the equilibrium type of approved manufacture and capable of reducing the pressure to the valve required as per plan and Bill of Quantities.

11.8.6 Water Meter

This shall be provided if required by MWSC as per their specification and approval.

11.8.7 Equilibrium Ball Valves

These should be of reputable manufacture approved by the Consultant and be of the angle pattern with gunmetal valve seats guide bush, copper float with wrought iron lever and links with bronze pins.

11.9 FITTING AND FIXTURE QUALITY

All sanitary pipes, gullies, water closets/bidets, squatting basins, sinks bathtubs etc., to be of approved design and to be obtained from approved manufacture and to be of the best stoneware glazed inside and outside, with burnt hard and sound, free from flaws, blisters, cracks and other imperfections and best quality commonly called 'firsts'. Rates should include for all bends, junctions, traps, specials, cleaning, painting, fixing clear of wall etc., complete as specified as per bill of quantities.

All pipes, fittings, flushing cisterns, valves, stop cocks, taps, tanks, surface boxes etc., to be of the best of their kinds and in addition to complying with previous clauses to be from approved manufacturers and all taps, cocks, valves etc., to be screwed down pipe. All tanks to be made fly-proof and to the complete satisfaction of the Consultant. All lavatory basins, sinks etc., must be fixed at least 12mm, the latter method of fixing is preferable. Rates should include for all cutting and waste, bends, taps junctures, cleaning eyes, tees.

11.10 MANHOLES AND MANHOLE COVERS AND FRAMES

Concrete cover slabs or top rings of manholes shall provide a suitable seating for a rectangular cover and frame having a clear opening 0.61m x 0.457m or alternatively a circular or double triangular cover and frame having a clear opening of 550mm dia depending on the type of c.i manhole cover to be used, and the rate for manholes shall allow for such provision.

Where the supply of c.i manhole cover and frames is not payable separately the cost of setting, surrounding, painting and materials for same shall be allowed for in the rate for manholes.

Suitable lifting rings, hooks or brackets shall be provided in the precast manhole sections. Box holes shall be separately grouted with 1:2 cement mortar.

The Contractor shall supply two manhole keys for each pattern of cover without additional charge over the rate for covers (or manholes).

Heavy duty (grade a) cast iron manhole cover and frames shall be of the double triangular type to b.s and having a clear opening of 550mm dia.

Medium duty (grade b) cast iron manhole covers and frames shall be of the circular type having a clear opening of 550mm dia or the rectangular type having a clear opening of 0.457m x 0.61m and conform to bs. They shall be of the single seal type, the weight of cover frame being approximately 127.00 kgs.

Light duty (grade c) cast iron manhole cover and frames shall be of the double seal flat type having a clear opening of 0.457m x 0.61m conforming to BS. Weight of cover and frame approximately 50.75kgs.

All manhole covers and frames shall be supplied, coated with a black bituminous composition and be given two coats of bituminous paint after bedding.

No extra rate is payable for drop and/or junction manholes but piping in and surrounds of drop lines are payable at that relevant rates for sewer piping and manholes.

In drop manholes where the difference in level between the incoming drains and the sewer does not exceed 0.610m in 75mm and there is sufficient room in the manhole, the connecting pipe may be brought directly through the manhole wall, and the fall accommodated by constructing a ramp in the benching of the manhole. The ramp shall be of concrete and finished equal to that of the benches. No extra rate is payable.

All swg gravity sewer lines should be, connected through an intercepting manhole before connecting to the main sewer line, and the dimensions of the manhole and trap to be in conformity with mwsc.

11.11 FIXTURES AND ACCESSORIES

Maker, class and colour shall conform to the drawings and particular specifications or the instructions of the Consultant.

11.12 AS-BUILT DRAWINGS

The Plumbing Contractor, shall mark down with red pencil on two sets of plumbing plans all the revisions, omissions and/or additions to the various plumbing installation drawings as the construction progress. One set of the plans as marked shall be submitted to the Consultant after completion of the work.

Before the final payment is made to the Contractor, he shall submit to the Owner two sets of all As-Built Drawings incorporating the changes made and noted in the marked plans retained by him. The As-Built Drawing incorporating all the changes made and noted in the marked plans retained by him. The As-Built Drawings shall be prepared on reproducible form.

The Plumbing Contractor shall prepare and submit the As-Built Drawings without extra cost to the Owner.

11.13 MISCELLANEOUS

Throughout the construction period, open ends of all installed pipelines shall be kept closed by temporary plugs. Drainage lines shall not be used to conduct dirty construction wash-washer, especially, those with cement, to avoid possible clogging.

A temporary fire protection system at each building shall be provided by the Contractor during the construction period. This shall be of sufficient capacity to put out any fire that may break out at any of the building floors due to construction period. This in addition to temporary fire extinguishers required.

A temporary potable water supply shall be available to construction workers at each building floor as construction work progresses.

A temporary human Excrete Disposal System shall be provided by the Contractor to serve the workers during the construction period.

MECHANICAL

- 12.1 General
- 12.2 Materials and Installation Procedures
- 12.3 Tests and Adjustment Works
- 12.4 Guarantee

12 MECHANICAL

12.1 GENERAL

12.1.1 Scope

The work covered by the part of this part of specifications consist in performing all operation in connections with the supply and installation of the air conditioning and ventilating system, complete in strict compliance with the specifications and applicable drawings and subject to terms and conditions of the contract.

- (a) Work include furnish and install VRV & single split Air Conditioning units and ventilation systems to general areas to include, lobbies, entrance ways, switchboard/electrical room, office spaces and lift machine room.
- (b) Furnish and install ceiling Ventilating Fan to pump rooms, toilets and heat recovery VRV ventilating system in office areas as shown on drawings
- (c) Furnish and install ventilating air duct system
- (d) Furnish and install refrigerant piping system
- (e) Furnish and install Electrical power and control system as shown in the plans.
- (f) Testing, balancing and commissioning of the system.

12.1.2 General Conditions

The contract drawings indicate the extent and general arrangement of the air conditioning and ventilating systems. If departure from the drawings is deemed necessary by the Contractor, details of such departures and reason therefore shall be submitted to the Consultant for approval. No such departure shall be made without the prior approval of the Consultant or his representative.

12.1.3 Standard Products

The Contractor shall submit, as soon as practicable after award of contract, a complete schedule of equipment for installation shall be submitted to the Consultant or his representative for approval prior to purchase of these units. Equipment shall be a standard product of a reputable manufacturer. Air conditioning system shall be Daikin, Hitachi, Mitsubishi or similar.

12.1.4 Shop drawings

As practicable, after award of contract and prior to installation, a complete shop drawings, showing the sizes and type of equipment, together with complete piping layout and electrical power requirement shall be submitted to the Consultant or his representative for approval. This holds true also for air duct system.

12.1.5 Government permit and Certificate of Inspection

Prior to start of installation, the Contractor shall secure a permit to install from the authorization agency having jurisdiction over the place of installation and before final acceptance by the Client. Fees and other expenses incurred due on these permits shall be borne by the Contractor.

12.1.6 Local Laws and Ordinances

Aside from herein specified the equipment and installation materials, installation of the system shall confirm to local Laws, Codes and other ordinances that are if force in the country.

12.1.7 Description Of System

The air conditioning system shall be VRV for the general office spaces and lobbies and the rest shall be single split type air conditioners.

Fan Coil units shall be of Ceiling Mounted type, horizontal throw and cabinet model as specified.

All condensing units shall be designed for outdoor installation with anti-corrosive treatment

Electrical power supply shall be 230 volts, 1 phase, 60 hz. for the equipment and 400volts 3phase 50Hz respectively.

12.1.8 Description Of Equipment

VRV outdoor unit shall be treated with anti-corrosion paint, specifically for use in salty conditions. Especially the heat exchanger shall be treated with anti-corrosion treatment.

The unit shall be supplied with diverter hood on the air outlet side.

12.2 MATERIALS AND INSTALLATION PROCEDURES

12.2.1 Piping System

12.2.1.1 Refrigerant and Condensate Piping

Refrigerant pipe shall be type L hard drawn seamless copper, suitable for a working pressure of 2413 kPa. Fittings shall be wrought copper or brass designed for use of high temperature solder and suitable for working pressure of not less than 2413 kPa. Joints from soldered to threaded joints shall be made with a standard adapter fittings using high temperature solder. Pipes and fitting shall be cut accurately to measurement established at the building lines. All piping shall be laid straight and no piping or tubing shall be laid against other materials without insulation. After cutting, the tubing shall be reamed, all burred removed and internal surface internally cleaned. While soldering pipes and fitting together, a continuous flow of inert Nitrogen gas must be applied to sweep the internal surface of the tubing to avoid the formation of oxide inside.

Condensate drain piping shall be galvanized PVC pipe. A P-Trap with a clean out plug shall be provided at the outlet of each pan.

Pipe support and hanger shall be provided and fabricated in a workmanship manner out of angle bar, rod, and flat bar. Metal to metal contact between pipes and hangers shall be avoided by providing 3mm thick rubber in-between. Supports on horizontal lines shall spaced at not more than one meter on center. All piping shall be anchored so that no stress is placed on the equipment connection by expansion.

Pipe sleeves shall be of standard steel pipe with sufficient diameter to provide minimum clearance of 6mm around the pipe and in the case of insulated pipes approximately 6mm around the insulation. Pipe sleeve shall be installed whenever pipe penetrates a masonry or concrete wall and floors. Pipes shall not be permitted to penetrate walls, beams, or column unless permitted by the structural Consultant.

12.2.1.2 Vibration Absorbing Foundation

All times for mechanical equipment such as Air cooled condensing unit shall be properly isolated from the building structure by means of Vibration absorbing foundation. Each foundation shall include an adequate number of standard isolation units or as specified by the equipment manufacturer.

12.2.1.3 Valves and Pipe accessories:

a. Refrigerant Valves

Valves shall be installed in the suction and discharge lines adjacent to the compressor or unless built-in valves are furnished on the liquid line of the discharge side of the condenser. Valves shall be wrought copper or brass for use with R-22 and suitable for a working pressure of 350 psi.

b. Thermostatic Expansion Valves

Expansion valve of proper capacity shall be installed in the refrigerant supply line to the evaporator. They shall be of the diaphragm type externally equalized and shall be such optimum size as to maintain a full active evaporator under all load condition and yet reduce the possibility of flooding the compressor with refrigerant during loads.

c. Solenoid Valves

Solenoid shall be installed as required and shall be designed for the operating pressure of the system. Valve capacities shall be based on the pressure drop across them but not to exceed 3 psi.

d. Dehydrators

Dehydrator in combination with strainer shall be installed in the refrigerant line to indicate whether or not the system are properly charged and to monitor the dryness of the system.

12.2.2 Air Duct System

Duct shown in the drawing, specified or required for ventilating system shall be constructed and erected in a first class workmanlike and air tight manner, all in accordance with the recommendation of CIBSE. Sheet metal thickness for different duct sizes shall be in accordance with the standard guides.

Unless otherwise directed by the Consultant, ducts shall conform accurately to the dimension and reasonably true to the locations indicated in the drawings. The duct shall be straight and smooth in the inside with joints neatly finished and air tight.

12.2.3 Hangers and supports

Ducts shall be braced and reinforced with angles, supported and securely anchored to the building in an approved manner so as to be quite and completely vibration free.

Curved elbows shall have a centreline radius of not less than 1-1/2 times the width of the duct. Splitter damper and turning vanes shall be constructed one gauge heavier and of the same material as to the duct in which they are installed. Turning shall be double thickness type. Splitter dampers shall be provided with lubricated bearing in both ends of the shaft and externally adjusted with locking devices.

Horizontal ducts shall be supported by 25mm x 25mm x 3mm flat mild steel bar if under 760mm wide and 25mm x 25mm x 3mm angle mild steel if under but not to exceed 2430mm. The bracing shall be use by extending the vertical portion. Vertical ducts shall be supported on the floor slab or structural steel member.

12.2.4 Fire Dampers

Fire dampers shall be provided in every duct that passes through firewalls or where indicated in the plans. Fire dampers shall be fabricated from heavy gauge black iron sheets as shown in the drawings and equipped with fusible ink set to melt at 73.88 C. the details of the construction is shown in the drawing. Access door at fire dampers shall be large enough and so located that damper blades may be repositioned and fusible link replaced.

12.2.5 Flexible Connectors

Flexible connectors shall be provided between ductwork and equipment to which they are connected to prevent the transmission of vibration. Materials shall be heavy canvass cloth closed weaved so as to rendered practically airtight. The necessary angles, bolts, clips and other fastening for securing the flexible materials to the equipment and air duct shall be provided.

12.2.6 Diffuses and Grilles

Supply and exhaust grilles shall be double deflection horizontal and vertical face bars. They shall be fabricated from gauge 20 B.I. sheets, bonderized after fabrication and finished with baked on enamel paint. Exhaust and fresh air louver shall be fabricated of the same materials as the grilles and shall have curved and hammed edges to give attractive appearance as well as rigidity and strength. The curved blades shall be stationary or fixed type.

Supply air diffusers for the kitchen for the kitchen working area shall be ceiling perforated model fabricated and install as on the mechanical plans.

12.2.7 Flexible Air Ducts

Flexible round duct shall be annealed Aluminium formed into multiple corrugation and encased with 25mm fibreglass insulation with aluminium reinforced foil. Ducts shall be suitable for negative or positive operating pressure of 500 Pa water gage.

12.2.8 Duct Insulation

All air handling, air conditioning ducts shall be insulated with 60mm Fibreglass insulation, 48 kg/cm with factory applied reinforced Aluminium foil. Refer to mechanical plans for installation details.

12.2.9 Finishing Works

Pipe hangers, un-insulated piping and other ferrous materials that has not received factory painting shall thoroughly be cleaned and given two coats of rust preventive paint.

12.3 TEST AND ADJUSTMENT WORKS

Upon completion of installation and when the system is ready for operation, capacity and general operating test shall be conducted by a competent and experienced Consultant to be furnished by the Mechanical Contractor. These test shall demonstrate the specified capacities of the equipment.

A direct reading velocity instrument, that has recently calibrated, shall be used to show the air flow in the areas that has been regulated as to deliver the required air quantities at their respective supply and exhaust outlet. Supply air temperature, motor load and speed shall be taken and related to the specified equipment. The Contractor shall furnish all necessary instrument such as ammeter, voltmeter, pressure gauges, tachometer and other instrument to enable him to carry out the comprehensive test of the equipment and the system.

12.4 GUARANTEE

The air conditioning and ventilating system and equipment furnished and installed under this part of specifications shall be guaranteed for period of one (1) year from the date of acceptance thereof. Materials furnished and workmanship shall be free from defects and same shall be guaranteed for one year from the date of acceptance. At any time within one year after acceptance and upon proper notice, the Contractor shall rectify any and all deficiencies including replacement of parts or the entire unit without additional cost to the client, if such deficiencies have been caused directly or indirectly by inferior materials, faulty workmanship and or defective design of parts. During the guarantee period the Contractor shall perform free monthly inspection and make necessary adjustment if necessary for efficient operation of the system. Expendable materials such as refrigerant, oil, belt and air filters are included in this one (1) year guarantee.

LIFT

13.1 Variable Voltage, Variable Frequency Control Specification For Passenger Lift.

13.2 Lift

13.3 Entrance Indicators

13.4 Special Features

13 LIFT

13.1 LIFT

CAR SPECIFICATIONS	:	Similar to Mitsubishi P6 and P13
CAR INTERNAL DIMENSION	:	P6 - 1400mm (W) x 850mm (D) and P13 - 1600mm (W) x 1350mm (D)
NO OF FLOOR SERVING	:	Three Floors
RATED SPEED	:	90 / 105 m/min
CAR CEILING, LIGHTING &	:	Baked enamel painted steel sheet in elected with bright fluorescent lighting through milky white plastic cover and ventilation by electric blower with slip vents with plastic grill located adjacent to lighting fixture as per catalogue.
FRONT RETURN PANEL	:	Inclined type in hairline finish stainless steel.
CAR WALLS & DOORS	:	Plastic laminated finish in colour selected.
ENTRANCE COLUMNS	:	In hairline finish stainless steel integrated with front return panel.
CAR SILL	:	In extruded hard aluminium.
CAR FLOORING	:	In hardwearing vinyl tile.
LANDING ENTRANCES	:	Type E102 lintel & jamb in baked enamel painted steel finish.
HOISTWAY DOOR AT ALL FLOORS	:	800mm (W) x2100mm (D) 2 panel centre opening automatic doors in baked enamel painted steel finish in colour selected.
LANDING SILL AT ALL FLOORS	:	Extruded hard aluminium.
ACCESSORIES	:	Provide SS handrails and mirror finish at the back

13.2 ENTRANCE INDICATORS

ALL FLOORS	:	PIM-A110 type hall position indicators with micro/click type button and LED response light, display panel being in smokey gray plastic in matt finish with direction and position indicator digital type, LED dot display orange when illuminated, flashing direction light on car arrival.
SIGNALS IN THE CABIN	:	Type CBM A110 Car operating panel with face plate in plastic in dark grey, display panel in smoky grey plastic in matt finish, but call buttons in micro/click button in grey plastic with direction and position indicator with digital LED dot display & orange when illuminated with response light also LED.

13.3 SPECIAL FEATURES

Entry at opposite ends at ground floor only

Safety door edge on one side

Interphone

Dc alarm bell

Emergency car light

Overload audible plus visible

Arrival chime

Handrail on rear side

Independent operation for restricted access

Variable Voltage Variable Frequency Inverter controlled doors.

VVVF inverter to control opening/ closing of the doors, making operation much quieter and smoother.

Power on Relevelling

If the lift car stop at a door zone due to failure of normal power the car shall level to secure the floor level with the doors open after normal power has restarted.

Door Sensor Self Diagnosis

If a non-contact door sensor fail, the system shall automatically determine the timing of door closing to maintain the lift service.

Automatic Door Speed Control

The system shall monitor actual load condition at each floor and shall automatically adjust the door speed and torque.

Automatic Door Open Time Adjustment

The system shall judge the situation of whether each car stops responding to a car call or a hall call and shall control the time the door stays open, accordingly the time spent waiting for the lift is shortened, and operating efficiency is increased.

Re-open with Hall Button

When the doors are closing, they shall be re-opened by pressing the hall button.

Repeated Door Close

Should an obstacle prevent the doors from closing, the doors shall repeatedly open and close until the object is removed.

Door Nudging Feature

In the event of any door safety device malfunction, a temporary override function shall automatically engaged to close the doors, thereby preventing a fault in the lift operation. Once the doors close completely, the override shall be cleared and normal operation shall resume.

Car Call Cancelling

When a car responds to the final car call in the ascending or descending direction, the system shall automatically check and clear them from memory, thus keeping operating efficiency high.

Safety Landing

This feature is designed to prevent passengers from being stranded in the car when a lift malfunctions and stops between floors. The source of malfunction shall automatically be searched out, and when lift operation is determined to be safe, the car shall proceed to the nearest safe landing at reduced speed and the doors shall then open.

Next Landing

If a lift door becomes jammed for some reason (eg. a pebble) and the passengers are unable to get off at the desired floor, the lift shall automatically proceed to the next floor with functioning doors.

Door Load Detector

When an object is caught in opening/closing doors, the doors shall reverse direction when an excess load is detected. For example, when a pebble becomes lodged in the door track, rather than forces itself open/closed the reverse cycle is repeated until problem is eliminated.

Extended Door Open Button

The car shall keep the doors open for an extended period to allow loading of materials, luggage, etc.

SAFETY	:	Gradual
BUFFERS	:	Spring
GUIDE RAILS	:	Steel T Sections
COUNTERWEIGHTS	:	Cast iron blocks enclosed in steel
POWER SUPPLY	:	400 Volts 3 Phase 50Hz.
LIGHTING SUPPLY	:	230 Volts 1 Phase 50 Hz.

Please note that 100% of the lift component including finished items such as: door frames, door jambs, cabin walls and panels will all be supplied by the Manufacturer and no locally fabricated materials shall be used.

Electrical Installations

- 14.1 General
- 14.2 Scope of Work
- 14.3 Pre-qualification
- 14.4 Rules and Regulations
- 14.5 Standards
- 14.6 Climatic Conditions
- 14.7 Specifications
- 14.8 Submittal
- 14.9 Drawings and Data
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- 14.11 Spare Parts List
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- 14.13 As-built Drawings
- 14.14 Test Reports
- 14.15 Conduits and Accessories
- 14.16 Wires, Cables and Codes
- 14.17 Wiring Accessories
- 14.18 Light Fixtures
- 14.19 Main L.T Switchboard
- 14.20 Switchboard Testing
- 14.21 Distribution Board
- 14.22 Power Supply
- 14.23 Fire Alarm System
- 14.24 Lightning Protect System

14 ELECTRICAL INSTALLATIONS

14.1 GENERAL

The work shall be carried out strictly in accordance with the standard specifications and shall also conform to the requirements of electricity rules in force in Male', republic of Maldives.

All materials to be used in the works shall be of standard make and shall bear the certification marks of their respective testing or regulatory authority. All materials shall be approved by the Consultant before use in the works.

Earthing shall invariably be done in the presence of the Consultant or his representative.

All the conduits shall be continuously earthed. Check nuts shall be provided at the point where the conduct enter the I.C. box and junction box.

The Contractor shall arrange for the inspection of all medium pressure installation by the Electrical Inspector of the local electric supply authority from where the electricity connections has to be obtained, and see that they are passed by him. All the expenses for this testing shall be borne by the Contractor

The Contractor shall be responsible for all necessary permits, approvals, fees, deposits etc., Required to complete the electrical works in accordance with the contract.

14.2 SCOPE OF WORK

The work consist of furnishing all tools, plants, labour, materials and equipment and performing the internal electrical Works comprising of:

- (a) Light and power wiring
- (b) Fans and fixtures
- (c) Wires and Cables
- (d) Fire Alarm System
- (e) Telephone System
- (f) Sub- Station Equipments:
- (g) Distribution Fusegear
- (h) Earthing System
- (i) Lightning Protection System
- (j) Air Conditioning System
- (k) Computer cabling system
- (l) Emergency generator

14.3 PREQUALIFICATION

The Electrification Work shall be carried out only by a licensed Contractor authorised to under take such work under the Maldives Electricity Bureau.

A licensed Electrical Contractors shall have the following qualifications:

- (a) Must have in his employment a competent Electrical Engineer registered with Maldives Electricity Bureau.
- (b) Must have in its employment an Electrical Consultant having certificate of competency who will exclusively supervise this work.
- (c) Must have necessary tools, plant and instruments.
- (d) Must have adequate experience of similar works.
- (e) If a Contractor does not posses the above qualifications he shall be allowed to sublet the Work to a competent Sub-Contractor provided an application for his pre-qualification is made to the Consultant for his approval. Decision of the Consultant in this case shall be binding on the Contractor.

14.4 RULES AND REGULATIONS

The installation in general shall be carried out in conformity with the Electricity Rules, 1937 (UK), and the latest edition of the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers, London (I.E.). However, in case of conflict between these Specifications and the I.E. Regulations, these Specifications shall be followed.

14.5 STANDARDS

The latest relevant British Specifications, and I.E. recommendations shall be applicable and be followed for the equipment specified herein.

14.6 CLIMATIC CONDITIONS

All equipment supplied shall withstand, without developing any defect, the following climatic conditions:-

Maximum Ambient Temperature	=	113° F or 45° C
Minimum Ambient Temperature	=	28° F or - 2.2° C
Maximum Humidity	=	98%

14.7 SPECIFICATIONS

The Contractor shall furnish all material and equipment at site, confirming fully to the specifications given herein and to the accepted standards, the Institution of Electrical Engineers, London, and the Maldives Electricity Bureau. It is not the intent of these Specifications to include all details of design and construction of various material and equipment to be supplied under this contract. The Contractor shall supply and install all material and equipment specified herein and also all installation and small material such as nuts, bolts, washers, shims angles, levelling material, insulation, tape, solder, etc. and all such required for complete installation as intended by the Specifications.

The Contractor shall provide for all the required technical and non - technical personnel, skilled and non - skilled labour, construction equipment, transportation etc., as required for the completion of Work in strict accordance the Technical Specifications laid hereinafter. All material and equipment supplied by the Contractor shall be new and in all respects conforming to the high standard of Engineering design and workmanship. All material and equipment which have to be supplied and installed by the Contractor shall be passed/approved by the Consultant; even if the same is exactly in accordance with the Bill of Quantities and Drawings.

14.8 SUBMITTAL

The Contractor, after the award of work, shall submit for approval of the Consultant all drawings and cuts of equipment, appliances, fixtures and accessories. Cuts, catalogues and drawings shall be clearly marked to indicate, the items furnished.

14.9 DRAWINGS AND DATA

14.9.1 Approval of Drawings and Data

The Contractor shall provide detailed electrical drawings, wiring diagrams, etc. for all electrical switchgear, fuse gear and all other systems etc. for the Consultant to review and approval. Three sets of equipment drawings shall be provided for obtaining approval. These drawings shall be signed by a Licensed Electrical Engineer.

14.9.2 Drawings and Data

Three sets of drawings and data for each equipment shall be furnished by the Contractor for the Consultant approval before commencement of work. The drawings to be supplied by the Contractor shall be as follows:-

Electrical Drawings showing:-

- (a) Single-line diagram of all switchboards & distribution boards
- (b) Detailed wiring diagram
- (c) All interconnections
- (d) Relays, their locations, and internal wiring diagrams
- (e) Other electrical devices including meters instruments and their wiring diagram

14.10 SHOP DRAWINGS

The design drawings do not show conduit routes and depict only the position of various fixtures and outlets. All the planning for the conduit routes shall be carried out, well in advance of the actual execution of work, by the Contractor to the satisfaction of the Consultant. For this purpose the Contractor shall prepare shop drawings and obtain prior approval of the Consultant. Three prints of each shop drawings shall be submitted for obtaining approval before commencement of work.

No piece of work shall be allowed to be executed at site without the availability of these approved shops drawings. These shop drawings shall clearly depict the load balancing chart of each Distribution Board. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

14.11 SPARE PARTS LIST

A list of spare parts required for the one year's operation of each equipment where deemed necessary together with unit price of each part, shall be supplied by the Contractor.

14.12 GUARANTEE

The Contractor shall furnish written guarantee in triplicate of the manufacturer for successful performance of each equipment. Such guarantee shall be for replacement, which may be found defective in material or workmanship. The guarantee shall cover a minimum period of 12 months effective from the date of completion certificate.

14.13 AS-BUILT DRAWINGS

The Contractor shall, during the progress of work keep a careful record of all changes and where the actual installation differs from that shown on shop drawings. These changes and revisions where the actual installation differs from that shown on shop drawings. These changes and revisions shall be accurately carried out on the shop drawings and submitted to the Consultant for approval. After approval these drawings shall become the property of the Owner. These updated and approved shop drawings depicting clearly all changes and revisions made on site shall be called As-Built Drawings. Reproducible tracings of all these As-Built Drawings shall be handed over to the Consultant in the form of a bound document. Final payment will be withheld until the receipt of the approved As-Built Drawings.

14.14 TEST REPORTS

The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by STELCO

14.15 CONDUITS AND ACCESSORIES

14.15.1 Conduit Pipe

The conduit for the wiring of lights, socket outlets and other systems shall be made of PVC conforming to BSS 3505/1968 Class-D.

The conduit shall have following wall thickness and standard weights:

Pipe Size	Wt/100Rf t.	Wall thickness
20mm dia	3.4 Kg	0.04 to 0.05
25mm dia	4.5 Kg	0.045 to 0.055

Steel conduit shall conform to BSS 31/latest. The conduit shall be enamelled with good quality non-cracking and non-flaking black paint.

14.15.2 Conduit Accessories

The use of factory made round PVC junction boxes shall be used and should have nipples to receive PVC pipe with force fit, shall be used for ceiling outlets. The wall type junction box shall also be PVC. Each junction box shall be provided with one piece cover which shall be fitted on the box with screws.

Conduit accessories such as switch boxes, socket outlet boxes, pull boxes and inspection boxes shall be made of PVC having dust tight covers. All boxes shall have required number of conduit entry holes. All the rectangular or square shaped boxes shall have nipples to receive PVC conduit force fit.

Manufactured smooth bends shall be used where conduit changes direction. Bending of Conduit by heating or otherwise shall be allowed only at special situations with the permission of the Consultant. Use of sharp 90 degree bends and tees is prohibited. Bends shall have enlarged ends to receive the conduit without any reduction in the internal diameter of the PVC pipe.

All accessories e.g. boxes, coupling, bends, solid plugs, bushes, reducers, checknuts etc. shall be equal in quality to the specified conduit.

The drawings do not show conduit routes and all the planning for arranging conduit routes shall be carried out by the Contractor to the satisfaction of the Consultant.

The entire conduit system shall be essentially completed before the wiring pulling is taken in hand. Each conduit run shall be tested for continuity and obstructions. All obstructions shall be cleared in an approved manner. Water and moisture that has entered any section of the conduit installation must be dried with suitable swabs to the satisfaction of the Consultant.

Adequate expansion joints shall be provided in all conduit runs passing across the expansion joints in the concrete slab of the buildings.

All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made.

14.16 WIRES, CABLES AND CODES

14.16.1 Wires & Cords

The wires & cords for the conduit wiring shall be single core, made of stranded copper conductors, PVC insulated, tested to B.S. 6004, 1975. The voltage grade shall be 300/500 volts or 450/750 V unless otherwise specified on Drawings and Bills of Quantities.

(a) For light or fan point wiring with 1.5 mm square or as specified in the BOQ.

(b) For power plug 15A wiring with 4mm square or as specified in the BOQ.

14.16.2 Installation Instructions

All wiring shall be continuous between terminations and use of connectors or joints shall not be used. Spur and tee connections are strictly prohibited.

Manufacturers recommended lubricant might be allowed to facilitate pulling of wires. Use of any kind of oil and soap is prohibited.

14.17 WIRING ACCESSORIES

14.17.1 Switches

Indoor switches controlling lights and fans shall be single pole, 5A, one or two way, suitable for 250V, 50 Hz. The body of the switches shall be made of moulded plastic, one, two, three or four gang with integral built in moulded plastic face plate.

Weatherproof switches shall conform to B.S. standard.

14.17.2 Switch Socket Outlet Units

Switch & socket units shall be single, pole, 3 pin rated 5A, 15A or 20A, 250V, 50 Hz. These shall be moulded plastic type with white integral built-in faceplate. Each socket shall have its control switch by the side of it on a common faceplate. Thus the complete unit specified in BOQ shall be as switch and a socket outlet unit.

14.17.3 Dimmer

The dimmer shall be recessed type as required and shall be approved by the Consultant.

14.18 LIGHT FIXTURES

14.18.1 General

The description of light fixtures is given in the Bills of Quantities, and stated on the Drawings, and all relevant material are described in this Section. The determination of quality is based on certified photometric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit samples of each and every lighting fixture specified for approval of the Consultant.

The type of fixtures with manufacturer catalogue reference are given in Bill of Quantities. The lighting fixtures shall be manufactured by M/s. Philips, M/s.RZB Lighting Thorne Lighting (Thorn: http://www.thorn.com.hk/thorn_ww/index.html) or equivalent and as approved by Consultant.

14.18.2 Incandescent Light Fixture

The glass globes/ shades/ diffusers of the incandescent light fixtures shall be first class quality glass free from any air bubbles or voids. The glass shall generally be of opal white colour unless otherwise specified. The shape of the glass may be spherical, hemispherical, flattened bottom or tablet shaped as required.

Surface mounted fixture shall have stove enamelled sheet steel body. It may also be satin brass or aluminium anodised finish as required. The fixing holes shall match the outlet box. Wall bracket light fixtures shall have back plates with matching holes of the outlet box and decorative finish as required.

All the lighting fixtures shall be suitable for local climatic conditions.

14.18.3 Fluorescent Light Fixture

All the light fixtures shall have lamps and electronic ballasts of the wattage specified. The fluorescent lamp shall be either 2 ft - 18 watts or 4 - 35 watts and the colour shall generally be day light, cool day light in the order of preference or as mentioned specifically. The fluorescent lamps shall be Philips to BSS 1853 but having a minimum useful life of 5000 hours. The new generation of 26mm dia 18 watts and 36 watts energy efficient lamps shall be preferred.

The ballast shall be totally enclosed electronic type suitable for operation on 220 V, 50 Hz, single phase supply, a wiring diagram, wattage, voltage and current ratings shall be printed on the body of the ballasts. The power loss shall not be more than 10 watts for 36 watts ballast. The ballast shall be noiseless in operation without any whistling sound. The manufacture shall be called upon to guarantee a trouble free life of 3 years, effective from the date of completion certificate.

The starters shall have radio-interference suppressers.

The internal wiring of the light fixtures shall be carried out at manufacturers factory with heat resistance wires of size not less than 1.5 mm square.

The louvers of light fixtures shall be made of anodized aluminium and/or moulded plastic. The diffusers shall be made of acrylic perspex.

All the lighting fixtures shall be suitable for local climatic conditions.

14.18.4 Installation Instructions

The light fitting shall be installed according to manufacturers recommendations or as approved by the Consultant.

Flexible connecting wires from outlet box to the fixture shall be provided by the Contractor; connector made of porcelain or thermoplastic material shall be provided and installed in the outlet boxes for connecting flexible wires to the point wires.

Outlet boxes or any openings in the ceilings and walls shall be covered with appropriately fabricated accessories to provide an Architectural entity to conceal them.

14.19 MAIN L.T SWITCHBOARD

14.19.1 Type of Main L.T Switchboard

The L.T. switchboard (panel board) shall be indoor type, free standing, free supporting, floor mounted, totally enclosed, sheet clad, dust and suitable for operation on 3 phase 4 wire system, 415 v , 50 Hz, AC supply . The boards shall be suitable for installation back to the wall and capable of front attendance. The switchboards shall be designed to suit service conditions and ensure security and safety during operation, inspection operation, cleaning and maintenance. The switchboards shall be designed and tested to IEC recommendations. Each panel shall withstand strain of 2000 volts insulation level for one-minute power frequency test.

The L.T. switchboard shall consist of the following:

- (a) State Electric Company incoming panel.

14.19.2 Distribution Feeder Panel

Single line diagram of the L.T. switchboard shall be approved by the Consultant before placing order for the switch board.

14.19.3 Earthing

The switchboard shall be effectively earth by means of a copper strip of 25mm x 3mm (1" x 1/8") cross -section bolted to connections near the bottom of the switchboard.

14.19.4 Accessories

Designations labels, lifting lugs, foundation bolts, interconnecting nuts bolts, and washers, thimbles, lugs, levelling shims cable glands and/or cable end box for all the sizes of incoming and outgoing cable shall be supplied with the switchboard.

14.20 SWITCHBOARD TESTING

14.20.1 The following tests shall be conducted on each completed switchboard

Type Tests

- (a) Temperature rise test
- (b) Mechanical endurance test
- (c) Making/Breaking Capacity test

Routing Test

- (a) High Voltage test

The Switchboard shall be tested to British/Electricity Council Standard 41-5. Preference shall however, be given to Switchboards fabricated from all components manufactured by only one manufacturer.

14.20.2 Installation Instruction

All labour, equipments, tools and plants required to complete the installation shall be provided by the Contractor. The Switchboard shall be fixed firmly on the floor in perfect line, plumb and level position. All incoming and outgoing cable connections shall be made from the bottom including Earth connections.

14.21 DISTRIBUTION BOARD

The distribution boards / consumer units shall be either free standing, cubical type or wall mounting type suitable for recessed mounting. Each distribution board / consumer unit (d.b.) Shall be tropical in design, fully dust and vermin proof and liquid repellent.

14.22 POWER SUPPLY

Package substation as specified in drawings

14.23 FIRE ALARM SYSTEM

14.23.1 General

The Contractor shall be under obligation to plan, supply, install, test, commission and maintain for the period specified elsewhere, a fire alarm system for this building. The proposed system shall consist manual call points & alarm bells on every floor. Ionisation/optical smoke detectors at Electric room office area and lobby. Maintenance room & pump room. Plus Fire alarm control panel at ground floor guards room.

14.23.2 Specifications

The system shall facilitate the detection of fires occurring in any part of the building by subsequent audible and visual indications. The system shall generally comprise of the following :-

14.23.3 Main Control Panel

The control panel will be perspex fronted panel and will display all screened labelling and indications by block LEDs mounted behind the front hinged cover. The control panel shall be mounted in pressed steel housing and provide the following functions and indications.

Fully monitored two wire circuit for each sensor zone (24V D.C.) as required.

Fully monitored two wire sounded circuit (24V D.C.) as required.

Change over relay contacts each rated 5 amps 240V A.C. (Resistive load).

Full test and isolate functions via a key-board located on the facia of the main termination housing to provide the following:-

Ability to isolate sensor zones.

Ability to isolate sounder zones.

Ability to test automatically zones with an auto reset facility to enable a single person to carry out testing.

Full LED display of all functions comprising of:-

- (g) System on, system fault, processor fault, alarm, zone supply fault, system supply fault, battery fault, charger/mains fault, sounder fault and sensor fault together with a test mode display which provides zone clears, zone open circuit and zone short circuit indication for individual sensor and sounder (bells) lines.

Sequence of sounder operation- All sounder (bells) and relay out-put sequences shall be completely programmable to enable future changes to be carried out with only soft ware changes.

The control panel shall provide the following functions and indications:-

- a) Twin LED display for system on, system fault, sounder fault, alarm, mains/ charger fault, main processor fault, sensor fault, alarm silenced, battery fault, supply fault and earth fault.
- b) Also five dedicated control functions on illuminated push buttons, which are key - isolated. These shall provide Evacuate, Buzzer Mute, Alarm silence, Lamp test and Reset controls.

Battery charger - the battery charger shall be an integral part of the main fire alarm control panel cabinet and shall be capable of fully recharging the stand - by batteries after a main's failure within 12 hours. The capacity of the batteries shall be sufficient to supply the standing load for the least 24 hours and the maximum alarm load for one hour. The system shall be suitable for operation on 220v single phase or 415v, 3- phase 50 hz supply.

14.23.4 Sensors and Sounders

The main control panel as described in the foregoing shall be capable of working with the following devices having common specification as under :-

- (a) Operating voltage 10-30 volts d.c (two wire system)
- (b) Ambient temperature 10 C to +80 C.
- (c) Humidity range 20 to 90 RH

(d) Altitude range	Sea level to 6000 meters
(e) Alarm mode	Self latching producing a resistance of 680 ohms across the supply line.

Photocell (optical) smoke detectors- the units shall operate on light scattering principle. An internal infra-red light source shall be pulsed, with the light beam ranged so as to by-pass a receiving unit. The presence of smoke shall scatter the light beam, causing it to be reflected on to the receiving photocell. An evaluation circuit shall measure the amount of light and shall compare it to a reference. The detector shall trigger in to an alarm state when the amount of smoke exceeds a pre-set level. To ensure against false alarms several pulse readings shall be taken and compared before the detector shall be triggered into alarm. The detectors shall conform to b.s.s. 5446 part -1 and shall have the following specifications:-

(a) Quiescent Current	Less than 100 microamps at 20 volts.
(b) Alarm Current	Maximum 60 mA
(c) Maximum Coverage	300 cubic meters
(d) Weight	250 grams approx.
(e) Diameter x Height	92 mm x 80 mm

Manual stations - this unit also named call point shall be break glass type that do not require a hammer. The frangible glass is pressed hand to break the glass, which shall activate the alarm. The call point shall conform to b.s. 5839 part-2

Alarm bells - the alarm bells shall be centrifugal type and the gong shall be 100 mm diameter or as specified. The unit shall be suitable for an input of 24 v d.c. And shall provide a normal output of 94 db at 1 meter.

Electronic sounders - the unit shall be primarily designed to operated on 24v.d.c. And arranged easily to generate a variety of sound signals: intermittent, continuous or warble tones.

14.23.5 Wiring

The wiring for the fire alarm system shall be carried out in PVC conduit in accordance with instructions contained herein relevant section. 2x2.5 mm square or 4x2.5 mm square PVC heat resistance insulated single core cable 300/500 volts grade shall be pulled in 1" dia PVC conduit laid for the purpose. Any spurs and tee joints in the wiring are strictly prohibited. Instructions contained in section -E.2.2 and 2.3 shall be followed.

14.23.6 Installation

The installation as a whole shall be tested and commissioned, in accordance with manufacturers instructions, to the entire satisfaction of the Consultant.

14.23.7 Shop Drawings

Shop drawing of the fire alarm system layout shall be submitted to the Consultant for approval.

14.23.8 Cable Ladder / cable tray System

General

The cable ladder system shall generally be installed in vertical riser ducts provided for the purpose for parallel runs of cables of various services. The cable tray shall be used on ground floor to run the cables to the respective riser ducts from electrical main panel.

The Contractor shall be under obligation to supply all labour, material and accessories for the completion of cable ladder installation strictly in accordance with the specification laid as under and as illustrated on drawing to the entire satisfaction of the Consultant.

Design

The cable ladder system shall be fabricated from 16SWG (2.5 mm) thick sheet steel strip and then hot dip galvanized. All fixing accessories e.g. rawl bolts, cable clamps, nuts and bolts used for the cable ladder system shall be hot dip galvanised. All cable ladder shall have standard length of 4000

mm and a width of 500 mm. The ladder and accessories shall be subject to the prior approval of the Project Manager before mass production is taken in hand.

Installation

The cable ladders shall be installed in perfect line and plumb on the surface of walls in riser ducts by means of galvanized rawl bolts 1/2" dia x 3" long. Alternate ladder step in each length of ladder shall be clamped to the ladder in a neat and orderly manner by means of cable clamps. Depending upon the number of multiple cable runs two or three parallel ladders may be installed, side by side, in the same riser ducts in case one ladder is unable to accommodate all the cable runs. Each cable ladder (or an assembly of two or three parallel cable ladders laid side by side) shall be solidly earthed with 1" x 1/8" copper tapes on both sides.

14.24 LIGHTNING PROTECTION SYSTEM

14.24.1 General

The Contractor shall be under obligation to supply all labour material, services and skilled supervision necessary. Shop drawing for the lighting system shall be submitted to the Consultant at least 4 weeks before commencing the work.

The contractor shall furnish and install as shown in the plans a conduit system with conductors as shown in the drawings.

Both ends of each set of conductors shall be properly identified with durable tags with the same identifications of both ends, at the outlet and the telephone terminal cabinets to facilitate the installations of the telephone instrument in the future and for trouble shooting purposes. Cable used shall be twisted and shielded 3 cables in the office area and the rest as shown in the drawing.

14.24.2 Workmanship

The installation shall be carried out by skilled and competent workmen so as to achieve top class workmanship.

Information Technology Network Cabling

- 15.1 General
- 15.2 Raceways
- 15.3 Poke-thru Series, Product Specifications

15 INFORMATION TECHNOLOGY NETWORK CABLING

15.1 GENERAL

The entire IT network will be based on a fibre optics backbone and a structured cabling system. A system of raceways and cable ducts shall run between the equipment racks and workstations. Also this network shall be based on an in-floor and open-space-system with floor boxes or poke-through devices (integrated multimedia floor boxes) at service points. The integrated multimedia boxes shall serve each point with filtered surge protected isolated ground AC power; unfiltered AC power; LAN connection; modem line and telephone.

15.2 RACEWAYS

Please note that brand names quoted in the following specs are for the purpose of maintaining and achieving specific standards. Therefore other brands of equivalent performance quality and workmanship is acceptable and maybe used on approval by the Consultants.

- A. Metallic Raceways:
 - 1. Acceptable product: Wiremold Systems or equivalent. (Wiremold Company homepage: <http://www.wiremold.com/>)
 - 2. Product description: Two-piece system of galvanized steel, nominal 0.050 inch (1.27 mm) metal thickness, having total assembled cross-section dimension 4.75 inches (120 mm) high by 1.75 inches (44 mm) deep, having cross-section area 7.14 square inches (4606 sq mm), consisting of the following:
 - a. Base.
 - b. Snap-on cover.
 - c. Removable longitudinal barrier, dividing raceway interior into two equal spaces.
 - 3. Finish: Gray polyester topcoat over gray primer, capable of being field-painted.
 - 4. Finish: Ivory polyester topcoat over ivory primer, capable of being field-painted.
- B. Fittings:
 - 1. Factory-formed units to complete indicated configuration of raceway systems, including, but not limited to, the following:
 - a. External corner units.
 - b. Internal corner units.
 - c. Flat units.
 - d. Blank end units.
 - e. Elbows.
 - f. Couplings: One per raceway joint location.
 - g. Wire clips: One for every 2 linear feet (609 mm) of indicated raceway configuration.
 - h. Replacement longitudinal barrier: One section for every 5 linear feet (1524 mm) of indicated raceway configuration.
 - 2. Provide full line of full capacity corner elbows and tee fittings and inserts for for retrofit, to maintain controlled 2 inch (51 mm) cable bend radius that meets TIA/EIA 569-A requirements for communications pathways and specifications for fiber optic and Category 5 cabling.
 - 3. Material: Same material and metal thickness as linear raceway components (0.40 inch [10 mm] galvanized steel).
 - 4. Finish: Matching linear raceway components.
- C. Device Brackets and Plates:
 - 1. Factory-formed brackets and plates allowing installation of indicated power, data, and communications devices, both single-gang and two-gang, either vertically or horizontally in raceways.
 - 2. Finish: Color matching linear raceway components.
- D. Cover Brackets and Face Plates:

1. Plastic device mounting brackets and trim plates allowing installation of indicated power, data, and communications devices horizontally in raceways; trim cover sized to overlap device cut-out in raceway, concealing seams.
 2. Finish: Color matching linear raceway components.
- E. Communications Devices and Accessories:
1. Communications devices: Factory-fabricated connectivity outlets, modular inserts, and other devices for indicated configurations and service requirements, including, but not limited to, the following systems:
 - a. UTP, including Category 5.
 - b. STP; 150-ohm.
 - c. Fiber Optics.
 - d. Coaxial.
 2. Mounting face plates and bezels.
 3. Identification accessories, including the following:
 - a. Pre-printed station and port identification labels.
 - b. Snap-in icon buttons.
 - c. Write-on station identification labels.
- F. Electrical Devices:
1. Factory-installed devices for indicated configurations and service requirements.
 2. Finish of sight-exposed components: Color matching linear raceway components.
- G. Electrical devices, and wiring for electrical devices, are specified in sections of Division 16.
- H. Fasteners: Types specified in manufacturer's installation instructions for project conditions.

INSTALLATION

- I. Install components of raceway system in accordance with shop drawings and manufacturer's installation instructions.

15.3 POKE-THRU SERIES, PRODUCT SPECIFICATIONS

15.3.1 Scope

The poke-thru described in this scope feeds power and telecommunication services to open space areas from the floor/ceiling space below. The poke-thru device provides both flush power service, as well as flush or recessed telecommunication service for Category 5 UTP, Category 3/4 UTP, Fiber Optic, Coaxial Audio, or Video connectors. The device will provide a non-obtrusive flush cover with "Dead-front" protection with slides that snap back into place to protect the receptacle when not in use. The standard product will contain a 20A or 20A IG duplex receptacle. The unit will provide all the inserts necessary to accommodate discrete keystone jacks from various manufacturers. The unit will also include two Dual Category 5 T568-B modular inserts.

15.3.2 RC3 Poke-Thru Series (or Integrated Multimedia floor boxes)

The RC3 Poke-Thru Series requires a 4" [102mm] cored hole opening. This cored hole must be made using an American made drill bit with an outside diameter of 4 1/16" [104mm]. The device will be secured in the slab with a spring steel retainer.

The total UL specified allowable copper cross sectional area for these units will not be less than .03592 square inches [.2 sq. cm.]. This copper cross sectional area refers to both power and telecommunication cables. Power and telecommunication isolation will be continued through the device with power cables terminated in an accessible junction box. The junction box shall have 24.8 cubic inches [406.4cu. cm.] of capacity.

The poke-thru cover shall be manufactured from textured Polycarbonate or PVC and will come in black, brass and ivory colours. The slide holder assembly shall be flush with the floor and provide "Dead-front" protection that allows the receptacle covers to snap

back into place when receptacle is not in use. The device shall also have accommodations for up to four telecommunication connectors. Each cover shall have individual slides that allow access to the telecommunication connectors and will close over the connectors when not in use. Telecommunication connectors shall be flush or recessed within the device.

The carpet flanges shall be manufactured out of die cast aluminium alloy and be capable of being powder coated or plated. Coated finish to be textured, two-stage epoxy paint in grey, black or ivory. Brass option will be a brushed solid brass forging.

The device shall be UL Classified for fire resistance for use with 1, 1 ½, or 2 hour rated, unprotected reinforced concrete floors and 1, 1 ½, or 2 hour rated floors employing unprotected steel floor units and concrete toppings. The intumescent fire stop material shall be encapsulated to prevent degradation.

The poke-thru device will contain as standard a 20A or 20A IG receptacle. This receptacle shall be prewired with three #12 THHN AWG conductors. For telecommunications, the unit will contain accommodations for up to four connectors for Category 5 UTP, Category 3/4 UTP, Fibre Optic, Coaxial, Audio and Video solutions. To accommodate the telecommunication solutions, the device shall accept discrete keystone type connectivity devices from various manufacturers. The device will be supplied with the necessary open system/unloaded inserts to make the telecommunication connections. All telecommunication inserts shall be non-metallic. The system shall provide for connection of other modular inserts for additional telecommunications options. The unit will also be supplied with two Dual Category 5 T568-B modular inserts.

Unit shall also accommodate a mechanism to permit protection of telecommunication cabling. Part shall be zinc die cast with two openings to accept both flexible and rigid conduit. Openings shall accept 1/2" [12.7mm] conduit.

15.3.3 Installation

Unit shall permit all wiring to be completed at floor level. Installation shall be completed by pushing unit down into cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer's instruction sheet included with each poke-thru unit.