

TECHNICAL SPECIFICATIONS

1. PRELIMINARIES

1.1 GENERAL AND PRELIMINARIES

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

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 Employers. 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 Employer.

The Contractor shall submit for the approval of the Employer 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 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 Employer'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 Employer 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 Employers.

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 Employer.

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

1.3 DRAWINGS AND SPECIFICATIONS

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

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

1.4 SAMPLES

The Contractor shall furnish for approval with reasonable promptness, all samples as directed by the Employer. The Employer 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.

1.5 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.

1.6 MANUFACTURER'S INSTRUCTIONS

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 Employer.

1.7 TRANSPORTATION TO THE SITE

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

1.8 SCAFFOLDING

The Contractor at his own expense shall provide, erect, maintain, dismantle, and clear away at completion proper and adequate scaffolding for the proper execution and completion of works.

1.9 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.

1.10 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

The Contractor at his own expense shall repair damage caused to adjacent facilities by demolition operations. 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

1.11 STORAGE AND PROTECTION

All materials shall be stored in protected areas on site and shall be fully protected against effects of weather. All delicate materials shall be carefully handled and stored under cover in a manner to prevent deformation and damage to the material and to shop finishes, and to prevent rusting and the accumulation of mud, dirt or other foreign matter on the metal work. All such damage and accumulation shall be corrected prior to erection.

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 dustsheets, barriers and guard rails and clear away same at completion.

1.12 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 Employer 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.

1.13 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 Employer and the Contractor shall be responsible for all additional costs incurred.

1.14 SITE CLEANING

The contractor shall clean up the site and dispose all unwanted materials from the site everyday and on completion of works to the satisfaction of the Employer.

1.15 SAFETY OF ADJOINING EXISTING STRUCTURES

The Contractor shall take all necessary precautions during the excavation for the Works particularly those excavation which are adjoining existing buildings, Curb Stones, pavements and shall protect such structures 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 Employer 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

1.16 OBVIOUS WORKS

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

1.17 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.

1.18 ELECTRICITY FOR THE WORKS

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

1.19 LEVELS AND REFERENCE POINTS

The Contractor shall satisfy himself that the existing ground levels as indicated in Contract are correct. Should there be any dispute regarding any levels, Contractor shall submit to the Employer a schedule of the levels considered to be in error, together with the values he believes to be correct. The ground relevant to the disputed levels shall not be disturbed until the Engineer's decision as to the correct levels is given.

The Contractor shall supply to the Engineer details of the value and location of the temporary benchmarks and reference points he proposes to use.

1.20 INTERFERENCE WITH ACCESS TO PROPERTIES AND APPARATUS

Before interfering with access to any property, the Contractor shall make adequate alternative arrangements for the occupiers.

The Contractor shall not obstruct access to any apparatus or utilities of any service or utility.

1.22 SAFETY

The Contractor shall comply with industrial normal safety practices for working in or around the site.

Contractor's workers should be provided with safety equipment in compliance with the acceptable industrial safety.

When working at Site the contractors should comply with Occupational Health and Safety (OH & S) standards and must comply with ESMP of the project. OH & S refers to the conditions and factors that affect or could affect the health and safety of employees or other workers (including temporary workers and contractors personnel), visitors, or any other person in the workplace. This includes, but not limited to

Wearing of Proper Site clothing.

Wearing of hard hats, gloves at working site.

Wearing Safety Shoes at working sites.

Maintaining a "First aid Kit" to attend to minor injuries that may occur during Site works.

Providing Safety Sign boards near areas where a danger or public related health issue may occur.

Providing Proper Barricading and Warning lights when an area such as an "excavated area is left open".

Wearing of Safety Mask/Gas Protection Mask when working with Hazardous chemicals.

And any other related safety precautions as per the site condition that may affect the health and safety of the workers or people involved in the workplace.

1.23 ENVIRONMENTAL PROTECTION

The Contractor shall take all necessary precautionary measures to ensure carrying out the works in accordance to acceptable environment norms, EPA guidelines and ESMP of the project.

1.24 SECURITY

The contractor shall ensure that the site is secure during the period of work and shall be liable for any loss or damage sustained as a result of their failure to comply with this condition.

The Contractor shall provide and maintain, night lights, road sign boards, warning tapes etc.

Where the works are in close proximity to buildings, walls or other existing structures, the contractor shall take adequate measures to prevent any damage to such structures. In addition before commencing work the Contractor shall submit details in writing to the Engineer's

Representative of his proposed method of carrying out these measures and shall not commence operations until these are approved in writing.

1.25 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 dustsheets, 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.

1.26 SITE HOARDING

The Contractor shall provide a site hoarding at the boundary of the Site as required by the Local Authority by laws and to the entire satisfaction of the Local Authority and the Consultant. 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 the same from trespass and providing all necessary watching and lighting in connection therewith.

1.27 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. 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 Consultant 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 Employer 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.

1.28 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.

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

1.29 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.

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.

1.30 SIGN BOARD

The Contractor shall provide and maintain a sign board for the Site consisting of a timber framed block board panel.

1.31 CONSTRUCTION SCHEDULE AND EXECUTION PLAN

The Contractor shall prepare and submit to the Engineer for approval a construction schedule and an execution plan of how he plans to carry out the works including any temporary facilities, stock yards, etc., before the start of the work.

1.32 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.

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

Inactive or abandoned utilities encountered during construction operations shall be removed, plugged or capped. The location of such utility shall be noted reported in writing to the Employer.

2. GROUND WORKS

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 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 Consultant.

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.

2.3 FINISH OF EXCAVATION AND INSPECTION

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

2.4 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. Dewatering shall be carried out with liaising to relevant local government authority and as per the government regulations in conjunction with the ESMP of the project.

2.5 SHEETING AND SHORING

Excavation for trenches shall be sheeted, braced and shored as necessary to prevent caving or sliding.

3. CONCRETE WORKS

3.1 CONCRETE

3.1.1 CEMENT

Cement shall, unless otherwise stated, be Ordinary Portland Cement of an approved brand and shall comply with the requirements and shall satisfy the tests contained in BS12.

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

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

The aggregates 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

Water used for mixing and curing concrete or washing aggregate 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. Potable water containing not more than 10 parts per million dissolved solids shall be used for all reinforced concrete work.

3.1.4 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.

Normal weight concrete grades (N/mm ²)	Characteristic compressive strength of cubes at 7/28 days (N/mm ²)		Maximum aggregate size (mm)
	7 days	28 days	
25	20	25	20

As soon as possible after commencement of the Contract, the Contractor shall prepare such trial mixes as required to satisfy the Consultant 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.

3.1.5 BATCHING AND MIXING OF CONCRETE

All concrete shall be batched by weight and mixed mechanically. Hand mixing shall be allowed if written permission has been given by the Employer.

Mixing Concrete:

Mixing shall be done in a mechanical mixer. The mixer drum shall be free of hardened mortar adhering to its inner surface. Before mixing commences the drum shall be primed by washing with rich cement grout. A measured quantity of dry course aggregate shall be first placed in the hopper. This shall be followed with the measured quantity of sand and then cement. The skip shall be raised and the dry material slipped into the drum.

The dry materials shall be mixed for at least four turns of the drum after which the correct quantity of water shall be added gradually while the drum is in motion, to ensure even distribution of the materials.

The total quantity of water for mixing shall be introduced before 25% of the mixing time has elapsed and shall be resulted to achieve the specified water cement ratio. The complete contents of the mixer shall be emptied before recharging. When the mixer is closed down for the day or for any period exceeding 20 minutes, the drum shall be flushed clean.

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

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

3.1.7 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.

3.1.8 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 loads 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.

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

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

3.2 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.

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.

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.

Lengthening of bars by welding and re-bending 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 300mm, 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 is 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
Main bars in floor slabs	30
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 MORTAR

3.3.1 Description

Mortar for bedding kerbs, channels, cover frames etc shall be 1:3 cement: sand mortar.

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

Mortar for use with blockwork shall be 1:4 cement: sand mortar.

3.3.2 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.

3.3.3 Mixing

Mortar shall be mixed thoroughly either by hand or mechanically until its colour and consistency are uniform. The constituent 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.

4. MASONRY AND RENDERING

4.1 MATERIALS

4.1.1 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.

4.1.2 Water

Water shall be as described under Concrete Works.

4.1.3 Sand

Sand for block manufacturing may be local white coral sand free from salts, debris & organic matters. Sand for plastering shall be river fine sand, free from silt, quality to be approved by the Employer. Source of sand shall be in compliance to ESMP of the project.

For use in plastering, sand is to comply with the requirements of BS1198 Table 1. Sand for masonry mortar shall be coarse sand.

4.1.4 Blocks

Blocks shall be manufactured with cement and sand with no defects. Local white sand may be used for the fabrication of cement blocks. 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. Source of sand shall be in compliance to ESMP of the project.

4.2 MORTAR

Mortar shall consist 1 part cement to 4 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.

Mixing shall be carried out by means of an approved mechanical 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 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 Employer

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.

4.4 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 Employer's instructions in this matter.

4.5 LINTELS

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

4.6 PREPARATION OF SURFACES FOR PLASTERING

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.

4.7 PLASTERING

Internal plastering is to comply with BS 5492.

The plaster for use masonry wall is to be composed of 1 part cement, and 4 parts of sand, and is to be applied the finished stated thickness.

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 working time permissible after the addition of water to the plaster or render mix is to be 30 minutes. Mixed plaster or render that has exceeded this limit is to be removed from the site and not re-tempered 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 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.

5. ROOFING AND WATERPROOFING

5.1 ROOFING

Roofing sheets, flashings, ridge capping and gutters shall be Zinka alumina natural colour roofing sheet unless otherwise specified. All other material to be used in the roofing work shall be good quality and approved type, if non standard type to be it is subject to Employer approval. Workmanship shall be to the highest standards and codes of practice.

The Contractor is to be solely responsible for providing a roof that is completely watertight and corrosion resistant and able to withstand expansion extremes likely to be encountered with temperature fluctuations. The Contractor is to ensure that the completed roof will be able to withstand normal pedestrian traffic at occasional intervals without sustaining damage of any description.

6. METALWORK

6.1 GENERAL

6.1.1 Material

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

All steel sections shall be as stated in the drawings and/or BoQ, if not stated of strength class 43 A.

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

6.2 FABRICATION

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

Cut section shall be free of any noticeable defect.

Deformation caused by cutting shall be corrected.

Those directed in the drawing shall be chiseled finish and completely attached.

Material shall be checked for bend, distortion, warp, etc. before fabrication.

6.3 QUALITY OF WORK

Metal work shall be fabricated carefully and accurately to ensure compliance with design and performance requirements, using types and grades of metal as specified for the purpose. The finished work must be free from distortion and cracks. Proprietary products shall be used to the recommendations of the manufactures.

Steelwork shall be fabricated and erected by competent, experienced persons and shall generally conform to B.S. 449: Part 2 - "Specification for the use of structural steel in buildings."

6.4 SHOP ASSEMBLY

The components parts shall be assembled in such manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers if any are provided. All tubular members shall be sealed so as to prevent the access of moisture to the inside of the members.

6.5 BOLTING

Bolts shall be of sufficient length to have at least one complete thread projecting beyond the outer face of the nut when tightened up. Washers shall be provided in all cases.

Shape of bolts, nuts and washers shall be in accordance with the requirement of BS4190 and BS 3692.

Quality of bolt shall be SC 34 A

Spacing of bolt holes shall be as directed in the following table.

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

Minimum pitch and end distance for light weight steel shall be more than 3 times and 2.5 times a bolt diameter respectively.

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

Bolt hole shall either be drilled open or reamed after subpunching. Punching can only be permitted for a material thickness less than 13 mm.

Rolled edge around a hole shall be removed.

Position of a bolt hole shall be precise so that the center of all holes aligns.

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

Shear bolt shall be provided with washers to keep the nut out side of grip.

6.6 WELDING

6.6.1 General

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

Steel shall normally be welded by the metal arc process conforming to B.S. 5135. Other methods shall be subject to the approval of the Employer.

Welding of stainless steel, aluminium alloys, copper alloys, bronze etc. and brazing shall conform to the appropriate British Standard where specified, approval and testing of welders and welding procedures shall be as B.S. 4870, B.S 4871 and B.S. 4872. Surfaces to be welded shall be dry. When rain is falling or during periods of high wind, necessary precautions shall be taken to protect outdoor welding areas.

Welding shall be so carried out as to ensure that:

1. Welds will be of good clean metal deposited by a procedure, which will ensure uniformity and continuity of work.
2. The surfaces of the weld will have an even contour and regular finish and will indicate proper fusion with the parent metal.
Welder shall have an authorize qualification in Maldives and approved by the Consultant.

6.6.2 Welding Machine

Arc welding machine shall be alternate or direct current type which provides sufficient and adequate current.
The field arc welding machine shall be provided with remote control for easy control of current.

6.6.3 Preparation

Welding shall be done as much down wards as possible using a jig such as rotary frame.
Welding rod shall be always kept in a dry area and if necessary dried by drying equipment.
Welding surface shall be free of water, scale or others injurious to welding work. Slag appeared on the created surface in the middle of welding shall be cleaned before starting again.

6.6.4 Fabrication.

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

6.6.5 Built-up

Jig shall be used to keep mutual position of materials in assembly.
Temporary bolt hole for assembly shall be bored with approval of the Consultant.
Proper amount of construction, predistortion or restrain shall be added to welding parts to attain precise finish dimensions and shape.
Welding materials shall be properly met in fillet welds.

6.6.6 Tack

Short bead shall be avoided for tack welding. The minimum length of tack welding shall be as follows. Plate thickness under 3.2mm Bead length over 30mm, from 3.2 to 25mm-40mm.

The end of joint, corner angle, beginning and ending point of final welding shall be avoided for tack welding.

6.6.7 Work

Type of welding rod, rod diameter, current, voltage and welding speed shall be selected in accordance with type of welding work.
Order of welding and movement of rod shall be determined so as that there shall be no deformation after welds.
Welding shall be carefully done in concealment in raining and strong wind.

6.6.8 Finishes

Surface of welds shall be as smooth as possible and size and length of welds shall not be less than designed dimensions.
Reinforcement of weld shall not exceed $0.1s + 1\text{mm}$ (s: Designated size) in filled welds.

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

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

6.6.9 Safety

Safe scaffoldings shall be provided for the field welds work.

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

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

6.6.10 Inspection

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

6.6.11 Correction

Welding parts having injurious defects shall be removed and re-welded.

When deposited metals gets cracked, at least 50mm from the edge of crack shall be cut off and re-welded.

When base metals gets cracked, it shall be replaced.

Under cut parts shall be corrected by attaching deposited metal.

Injurious deformation left on welding materials shall be corrected or reinforced.

6.6.12 Transportation

While transporting materials, care shall be taken for preventing from defect.

6.6.13 Erection and Field Painting

Material shall be stored on flat surface in order not to get distortion, twist or other defects.

Correction shall be made to those distortion or twisted before erection.

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

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

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

7. ALUMINUM DOOR AND WINDOWS

7.1 General

All windows and doors are to be constructed by approved specialist suppliers of light, medium or heavy section to suit location, local building regulations, and particular requirements noted on the drawing as to weight and profile.

All frames should be made to fit the actual openings with a 5mm clearance all round. Discrepancies in overall width or height exceeding 5mm will not be allowed and the frames will be rejected in such cases. Any small discrepancies shall have the gaps suitably backed and then filled with gun-applied water repellent mastic sealant.

All nuts, bolts, washers and screws used for assembly and fixing shall be of adequate strength for their purpose within the design and shall be stainless steel grade 18/8.

All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245 or ASTM C920. All spliced joints between mullions will be sealed with an approved silicone product, compatible with other sealants and packings used.

All ironmongery shall have the same finish as the frames and shall be approved by the Consultant.

7.2 Side hung windows, doors and ventilators

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

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

The shutters of the windows and doors should be assembled with concealed corners of high rigidity. Hinges should be concealed within the sections.

Hinges shall be anodised aluminium with stainless steel pins and nylon washers. Handles shall be anodised aluminium finished to match the aluminium sections and mounted with self-lubricating nylon washers.

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

7.3 Workmanship

Take site dimensions and submit Drawings as detailed elsewhere in these documents, showing elevations, plans and full size sections, proposed methods of fixing, proposed methods of forming joints, any proposals for fabricating large components in more than one piece.

Mechanical joints shall be tight with no visible gaps. Where screw heads will be visible after component is fixed, or raised screw heads would interfere with any moving part of component, use countersunk machine screws unless specified otherwise. Mechanical joints of components which will be located externally shall be bedded in bedding compound, including all mating surfaces, cleats and other fixings.

8. CIELINGS AND PARTITIONS

8.1 Plywood Ceiling and Partition

In room areas, timber framed concealed ceiling with Plywood/Gypsum/Cement board shall be provided unless otherwise specified. The joints and edges shall have timber beadings and finished with exterior quality non textured paints as per paint supplier's specifications.

9. PAINTING

9.1 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 painting work must be carried out according to paint manufacturer's instructions unless otherwise directed by the consultant. Appropriate primers and under coats shall be used on all surfaces to be painted.

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

The paint type shall be Nippon or similar brand and the Consultant shall approve the colour before placing the order.

9.2 PAINT SPECIFICATION

For interior apply Acrylic or similar alkali resisting primer sealer, apply putty grind by sanding to level uneven surfaces, finish with two coats of matt finish with acrylic copolymer emulsion paints.

For exterior apply Acrylic or similar waterproofing quality primer sealer, apply texture coat, and apply two coats of finish as per manufacturer's specifications.

Marine grade timber varnish for all timber doors, cupboard doors and other exposed timber members.

For surfaces below ground, apply bituminous paint.

9.3 MATERIALS

9.3.1 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, block work, plaster, plasterboard and the like- alkali priming paint.

9.3.2 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.

9.3.3 Finishing Paints

Finishing paints shall be a Nippon/Sherwin Williams or equivalent quality paint unless otherwise specified.

9.4 WORKMANSHIP

9.4.1 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 Consultant'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 Consultant's approval, no work shall commence until this approval is given in writing to the Contractor.

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 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.

9.4.2 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 Consultant.

Plasterboard surfaces shall have taped joints and the surface puttied to the satisfaction of the Consultant. 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.

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

9.4.3 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.

10. ELECTRICAL WORKS

10.1 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 local authorities. 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.

The Contractor shall be responsible for all necessary permits, approvals, fees. deposits etc., required to complete the Electrical works in accordance with the Contract.

Ceiling fans shall be KDK brand or equivalent and switches and sockets etc shall be ABB brand or equivalent.

10.1.2 Standards

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

10.1.3 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 Energy Authority. 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.

10.1.4 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 carries 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 and submit shop drawings and obtain prior approval from the Consultant before commencement of the work.

No work should be carried out without the availability of 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.

10.1.5 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.

10.1.6 Test Reports

The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by the relevant local authorities.

10.2 Conduit and Conduit Accessories

The main wiring for the building will be taken inside the slabs through a conduit system. Before concreting the slab the Contractor should produce a detailed conduit layout drawing and obtain approval from the Consultant. A system of access for power and communication lines below the carpet flow should be provided.

10.2.1 Conduit Pipe

The conduit for the wiring go flights, socket outlets and other systems shall be made of PVC confirming to BS 3505/1968 Class-D.

The conduit shall have following wall thickness and standard weights:

Pipe Size	Wt/100Rft.	Wall thickness
20mm dia	3.4 kg	0.04 to 0.05
25mm dia	4.5 kg	Wires, Cables and Cords

10.2.2 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 light circuit wiring with 2.5 mm square or as specified in the BOQ.
- (c) For power plug 15A wiring with 4mm square or as specified in the BOQ.

10.2.3 Installation Instructions

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

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

10.3 Wiring Accessories

10.3.1 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.

10.3.2 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 face plate. Each socket shall have its control switch by the side of it on a common face plate. Thus the complete unit specified in BOQ shall be as switch and a socket outlet unit.

10.4 Light Fixtures

10.4.1 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 utilisation, 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.

Outdoor lights shall be weather proof and is subject to the approval of the Consultant.

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.

10.4.2 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.

10.5 Testing

10.5.1 Tests

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.

10.5.2 Installation Instruction

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.

10.6 Distribution Board

The distribution boards shall be either free standing, cubical type or wall mounting type suitable for recessed mounting Each distribution board (d.b.) shall be tropical in design, fully dust and vermin proof and liquid repellent.