GENERAL REQUIREMENTS

01. GENERAL REQUIREMENTS

011 GENERAL

This section of the Technical specification covers items that are applicable to all parts of this Technical Specification. The specification in this section, whether stated or not are considered equally applicable to each section of the Technical Specification and the work in general.

012 SITE DESCRIPTION

The specifier shall indicate the following in detail.

A location map of the area shall be attached and possible sources of stone for masonry & aggregate, sand, timber, etc., shall be indicated.)

- Region, particular name and geographic bearing
- Elevation of area
- Geological & geotechnical conditions as last established by surveys & tests.
- Access Road - specify distance of tarmac, gravel & dust road and no access distances in Kilometers. If in the opinion of the specifier, the project Area is located in an area known to all prospective Contractors, only the required details shall be given.
- Availability of services like water, power, telephone, etc.

The climatic condition indicating the following details:-

- Seasons of rain, indicating the heaviest month of rain.
- Seasons of lowest & highest temperature.
- Months of high and low humidity.
- Prevailing wind and months of high wind velocity.
- Records of monthly rainfall, wind speed & humidity.

013 QUALITY ASSURANCE

01301 Submittals and Substitutions

013011 Submittals

The minimum acceptable qualities of materials and workmanship have been established in this Technical specification by reference to accepted standards, codes or descriptions of required performance. The Engineer has established requirements in each section for the advance submittal of data for review and approval. Such required data shall be submitted and reviewed and resubmitted as frequently as required until compliance with the specific requirements has been obtained.

Each data for submittal shall be carefully reviewed and verified for its compliance with the specific requirement of the submittals called for in each section of this Specification.

The approval by the Engineer of submittals is in no way considered as a guarantee or relief from replacing, the materials

supplied or work executed, if the materials and workmanship are found defective by tests carried out there after. Such materials and workmanship found to be defective shall be replaced at no cost to the Investor.

All data, samples, test results, certificates, designs, drawings, etc., to be submitted shall fully comply with the requirements as specified in each section of this Specification.

Data and document accompanying samples of materials for submittals shall be signed by the contractor as proof of their being submitted for the specific work under consideration.

The document shall bear, the date, reference of section to this Specification and other requirement as specified in the particular sections of this Specification.

Schedule of submittals required by the Technical specification shall be prepared and submitted to the Engineer in two copies immediately after the signature of agreement.

013012 Timing of Submittals & Substitutions

All submittals and requests for substitutions shall be made in advance allowing sufficient time for inspection, testing review and verification. They shall be submitted in such a way that enough time is left after approval, for the placement of order, delivery, manufacture, etc., prior to time for installation in accordance with the work schedule.

Submittals shall always be in groups to the extent possible.

013013 Substitution

Products and Workmanship established in the Specification are the basis for the quality of work in the Contract. Products to be incorporated in the work require approval prior to use. No materials or proposed Workmanship are to be substituted prior to approval. The phrases in the Specification "equivalent or equal, similar, etc.," indicating substitutions do not mean automatic approval unless such approval as been obtained prior to incorporation in the Works.

01302 Standards

The Technical Specification refers to codes and Standards to establish qualities and types of materials and workmanship and methods for testing of materials and work.

Where materials, workmanship and tests are required to meet a specific accepted standard, the minimum to be supplied executed shall be those meeting or exceeding specifically named Code or Standard.

When proof of the fulfillment of quality of materials workmanship and test is required such written evidence shall be presented to the satisfaction of the Engineer.

The details of the requirements of the accepted Standards and Codes in this Specification shall be verified and familiarized with prior to supply & execution as required by each Standard.

All items of work not complying with the specific standard, if rejected by the Engineer, shall be replaced at no cost to the Investor.

In the instance of reference to more than one standard the stringent of all shall govern.

Reference in the Technical specification is made to designate standards. This does not in any way prohibit the use of other "acceptable equivalent proved standards" approved by the Engineer from being used for the works. The use of such equivalent standards requires the specific approval of the Engineer.

Reference is made to the Standard and Codes promulgated by the Agencies shown against each standard. The standards and codes are available with the Ethiopian Building and Transport Construction Design Authority, BaTCoDA for inspection.

01303 Testing

The Standards and Codes are annexed to this section of the Technical specification.

013031 Test facility location

Depending on the complexity of the work the Contractor shall maintain adequate testing facilities in accordance with tests from recognized agencies materials, samples and installed work as required by the Specification or instructed by the Engineer.

Testing agencies shall require approval prior to carrying out the work.

013032 Testing of materials and works

Where no testing requirements are specified but become necessary, the Contractor shall get the testing done according to Instruction. The cost of testing shall be born as described in the costs section here under.

013033 Codes and standards for testing

Tests shall be carried out in accordance with the procedures set out in the Standards & Codes referred to in the specification. In the absence of such procedures other approved procedures shall be used.

013034 Costs of testing

Costs associated with preparation of materials for testing, transport, testing costs, obtaining of records, etc., shall be born by the Contractor, if such tests are required by the Specification or are determined necessary by the Engineer (whether or not mentioned in the Specification) for conformity of materials, workmanship and installed works to the requirements of the specification.

If re-testing is required such costs shall be born by the Contractor.

If tests are made for the convenience of the Investor/Engineer such tests shall be carried out or cause to be carried by the Contractor and related expenses reimbursed by the Investor.

01304 Samples

Samples shall be submitted or prepared in sufficient quantity as required by each item of work specified on each section of the specification or as required by the Engineer.

No materials or workmanship requiring sample approval shall be delivered or executed prior to obtaining approval for the samples.

All supplies and workmanship shall in all respects comply with the approved samples.

Samples shall be maintained in their original approved condition until permission to remove them is given by the Engineer.

Rejected samples shall be removed from site immediately upon receipt of such instruction. Such rejected samples if required shall be replaced by other samples to the satisfaction of the Engineer.

In the instance of executed work or materials supplied for samples not being acceptable for the item under consideration, but acceptable for other works, the approval of the Engineer shall be obtained prior to use.

01305 Qualification of Workmen

Adequate number of workmen who are skilled/trained and experienced in the necessary crafts and who are thoroughly familiar with the specified requirements and methods needed for the proper performance of the work in each section of this Technical Specification shall be provided by the Contractor.

In addition to this general requirement, the specific requirements as stated under each section of this Specification shall be met.

01306 Cost Included

Cost of materials [as indicated on drawings or specified in the Technical Specification, Bill of Quantities, Schedules, etc.], labour, equipment, tools, temporary works, supervisory personnel and related items required for the satisfactory execution of an item shall be borne by the contractor whether or not specified.

01307 Related Works Described Elsewhere

The Technical Specification has been divided into sections. In dealing with a section, works that are necessarily related to the section under consideration, but not included in that particular section are referred to under "Related Works Described Elsewhere".

The reference to the works described elsewhere shall be considered as if the works have been described in that particular section and equally applicable as far as the work is related.

01308 Surface Preparation

Surfaces to receive work shall be clean from earth, dust, debris and other material spattered as a result of preceding work prior to the placement of succeeding work.

The approval of the Engineer shall be obtained after surface preparation and before further work is executed on the prepared surface. In addition to the above the requirements of surface preparation of each particular section of this Technical Specification shall be complied with.

01309 Storage and Handling

Materials shall be protected against damage in transit to the site. Where materials are to be supplied packed, the manufacturers recommendation as to packing and stacking during shipment shall be adhered to.

Materials shall generally be stored at site in a manner that would prevent damage to the materials. The methods of storage & handling as specified under each particular section of this Specification shall be adhered to.

01310 Protection

Materials and work shall before and after installation, be protected from damage by storage, handling and work on other trade. In the event of damage to the materials, work or the surfaces, all repairs or, if repairs are unacceptable, replacement shall be made at no cost to the Investor.

Safety measures including the provision of helmets, gloves, medical care, etc., shall be taken to ensure that workmen are protected against injury and loss of life while on work.

01311 Shop Drawings

The consultant in scales large enough to show required materials, details of connections of the components and the detail of connections to other work shall submit shop drawings.

Shop drawings shall be accompanied by Technical Specifications indicating all details that cannot be shown on the drawings. Shop drawings shall be used only after approval is obtained.

Shop drawings requiring resubmittal shall be revised as request by the Engineer.

The shop drawings and accompanying document shall indicate the full address of the manufacturer including the proposed time of manufacture.

Shop drawings shall be submitted in one reproducible form and two copies with no additional cost to the Investor.

01312 ENGINEER'S APPROVAL

The phrases in the Technical Specification "approval, Engineer's approval, etc" shall be understood as obtaining the prior approval of the engineer and his representative in compliance with the powers of the Engineer as provided for in the Conditions of Contract.

014 PROJECT RECORDS

0141 Construction Schedule

01411 General

Adequate work plan, indicating delivery of materials and execution of the works within the time frame given for completion requires the preparation of work schedule as described hereunder. The Contractor shall use this same schedule to monitor the progress of the works and evaluate the performance. The Construction schedule once approved shall form an integral part of the Contract.

01412 Timing

Unless other wise instructed, the timing used in the schedule shall always refer to Calendar days, weeks or months.

01413 Details of Schedule

The schedule to be prepared graphically shall indicate the sequence of work, interdependence of activities, cash flow and other pertinent data as listed hereunder and as directed by the Engineer.

- Period of mobilization
- Start and completion dates of the various trade classified into sections of work including the following.
- Submittals of samples & shop drawings.
- Order and delivery to site of materials.
- Fabrication and installation of materials.
- Earliest and latest start and finish date of each activity including float.
- Final testing.
- Demobilization.
- Monetary value associated with start up to completion of works to enable the determination of Contractor's cash flow and Investors budget allocation.

01414 Review of Schedules

Construction schedule shall be prepared and submitted to the Engineer within 20 days of instruction to proceed with the work and in any case not later than the end of the mobilization period. The Engineer and re-submittal prior to the end of mobilizing period shall give consideration to the requirement of the review of the schedule.

Construction Schedule shall be reviewed as instructed by the Engineer at intervals of not more than three months during the Contract implementation period.

0142 PERIODIC REPORTS

The Contractor indicating the progress of works shall submit periodic weekly, monthly and quarterly reports.

The monthly progress shall indicate: -

- The activities carried out in the month and the total to date including value of work.
- Problems encountered, affected portions of work and their effect on sequential activities.

The Quarterly report shall indicate:-

- The activities carried out in the quarter and the total to date including value of work.
- The comparative effect of the activities to the proposed schedule.
- The problems encountered and their effect on the succeeding work and over all completion time.
- The validity of the float proposed in the schedule.
- Review of the Schedule of work.

0143 PROJECT MEETINGS

Project meetings involving the Investor, Engineer and Contractor shall be held at suitable locations, preferably at the location of work at agreed dates but no less than once a month to review the progress of work. The minutes of such meeting shall be duly recorded.

0144 PHOTOGRAPHS

Photographs on progress records shall be taken by the Contractor at instructed frequencies but no less than required to indicate critical work stages and progress. A minimum of one print of each shall be displayed at site and two copies submitted to the Engineer.

Full set of completed work photographs shall be submitted by the Contractor at the end of the work. The cost of all such photographs shall be borne by the contractor.

0145 AS BUILT DRAWINGS

The Consultant shall prepare as built final drawings and records of the works to give information of both visible and concealed work to enable the Investor carry out future changes in design or modification of works with ease and without measurement and investigation. Such records shall include all changed date and information up to the beginning of the Maintenance Period. [The as built drawings and records shall be reviewed by the Engineer and resubmitted by incorporating any comments.]

0146 OPERATION AND MAINTENANCE DATA

The Contractor shall provide maintenance data of the works to enable the Investor obtain adequate information on up keeping, maintaining and replacing sections of the works. The data shall consist of the following subsections at the minimum.

01461 Products

Product Data (manufacturer's or agent’s full address, reference of product, year of manufacture, product identification and location in work) and catalogue if available.

- Operation and maintenance instructions, Part name and Part Number of fast moving parts and nearest Supplier.
- Copies of guarantees and warranties for equipment.
- Any other relevant information assisting for maintenance and up keeps.

01462 Manufacture Shops

The full address of materials manufactured by shops based on their shop drawings including their date of manufacture and reference to shop drawings shall be provided.

01463 Sub-Contractors

The full address of Sub-Contractors, portions of work they executed and the period of execution shall be given.

01464 Submission of Manual

All manuals shall be presented in draft form for review of the method of presentation, contents and arrangement. The final shall be submitted incorporating review and comments.

01465 All project records are to be submitted in one reproducible form and two copies.

015 SITE FACILITIES

0151 CONTRACTOR'S CAMP

The Contractor shall, at approved locations provide erect, maintain and subsequently remove temporary living accommodation, offices, stores, workshop, sanitary facilities, fencing, compound, etc., necessary for the completion of the works.

0152 ENGINEERS FACILITIES

The Contractor shall provide the Engineer’s living facilities and office as provided for in the Bill of Quantities and maintain the same up to Contract completion and remove them at completion.

0153 SURVEYING EQUIPMENT AND ASSISTANCE TO THE ENGINEER

The Contractor shall provide and maintain surveying equipment, as described in the Bill of Quantities, surveyors, and assistants for the exclusive use of the Engineer. He shall also provide sufficient work tools like pegs, poles, paint, strings, spirit levels, and tools for checking the setting out of the works, etc., as required.

0154 ENGINEER'S AND INVESTOR'S REPRESENTATIVES TRANSPORT

The Contractor shall provide and maintain vehicles as specified in the Bill of Quantities for use by the Engineer, his representative and Investors Representative for use in connection with the works.

0155 SERVICES

The Contractor shall at all times provide and maintain and remove at completion the following.

Power supply for temporary and permanent works.

Potable water supply for all temporary facilities and workmen and adequate supply of approved quality of water for the works.

Approved means of sewage and garbage treatment and disposal.

Telephone or other communication between the site and his office, Engineer's Office and Investor's Office for use by himself, the Engineer and representative for the purpose of the work.

Fencing and security measures to protect the temporary and permanent works from being damaged or damaging other works or installations.

Access for Vehicles from nearest public road to the location of works.

First aid to workmen, Engineer’s or Investors representative or to third parties. The Contractor shall ensure that there is adequate arrangement to transport personnel to the nearest capable medical center in the instance of injuries requiring medical attention beyond first aid.

016 CLEANING UP

The Contractor shall, during the Construction period maintain and clean up both permanent and temporary facilities. He shall provide temporary site drainage to leave the facilities free of standing water, accumulation of scrap, debris, waste material, and maintain good standards of hygiene.

Inspection shall be carried out daily to ensure that sufficient workmen, tools and facilities are provided to maintain the standard of hygiene.

Final cleaning of the site and removal of all temporary facilities shall be carried out to approval at completion of works.

017 INSURANCE AND BONDS

The Contractor shall, at all times provide and maintain insurances, bonds and guarantees required by the Conditions of Contract and Instruction to Bidders and site meetings, for the faithful performance of the works.

018 ABBREVIATIONS & NOTATIONS

The following abbreviation and notation are used throughout the Technical Specification. The abbreviations and notations shall be understood as having the meanings as given to them hereunder.

Bat Coda	Building and Transport Construction Design Authority
BS	British Standard
ASTM	American Society for Testing and Materials
AASHO	American Association of State Highway Officials
ES	Ethiopian Standard
DES	Draft Ethiopian Standard
PVC	Polyvinyl Chloride
UPVC	Unplasticised Polyvinyl Chloride

019 UNIT OF MEASUREMENT

The unit of measurement to be followed in general is metric. The following units of measurement or their denominations are to be used in as far as possible.

- WEIGHT KILOGRAMME (KG), TON (TON)
- LENGTH METRE (M), CENTIMETRE (CM), MILIMETRE (MM)
- CAPACITY LITRE (LT)
- NUMBER (NO)

02. EXCAVATION AND EARTHWORK

02. EXCAVATION AND EARTHWORK
021 DEFINITION
022 GENERAL REQUIREMENTS

0221 Work Included
Provide all necessary tools, equipment and manpower necessary to satisfactorily execute excavation and earthwork.

0222 Related Works Described Elsewhere

Concrete work	Section	03
Masonry work	"	04
External works	"	16

0223 Quality Assurance
02231 Standards
Comply with the following standards

Density moisture test	AASHO T147
Grading requirement for aggregate	AASHO T11 & 27

02232 Qualification of Workmen
Operators of equipment and men guiding labourers in earthwork shall be skilled workmen thoroughly trained and experienced in the necessary crafts. Provide at least one person thoroughly familiar with the specified requirements of the work in this Specification.

02233 Submittal
Within a reasonable time, and in any case prior to excavation & haulage to site submit test Certificates indicating compliance of the suitability of selected fill material for the intended fill purpose.

In the instance of test not being carried out earlier, such tests shall be carried out by the Contractor at frequencies and as directed by the Engineer.

02234 Protection
Trees & shrubs required to be preserved for landscaping purposes shall be protected from damage. Damaged trees and shrubs shall be replaced at the Contractors cost.

Faces of excavations shall be retained with sheeting, timbering, strutting and shoring as necessary to protect workmen and to prevent damage to adjacent work, services structures.

If, sufficient support of the excavation is not being provided and the work is dangerous to workmen, or property or to permanent work, the operation shall be suspended until sufficient timbering or sheeting is provided as approved by the engineer.

All necessary temporary drains and culverts shall be constructed to keep the site free of water. Trenches and excavations shall be kept free of surface water by pumping or other means.

023 EXCAVATION
0231 EXCAVATION WORKS

02311 General

The Contractor shall, before starting excavation work satisfy himself as to the accuracy of the levels shown on the drawings or the directions given by the Engineer. Any discrepancies shall be reported to the Engineer prior to proceeding with the works.

Excavation shall be carried out to the lines, levels, width, depth and grades and shown on the drawings, directed by the Engineer or as appropriate to the works to be placed in the excavation.

Excavation shall be suitably trimmed and leveled before subsequent work is placed. In locations where the excavated material is loose, the bottom 100mm layer shall be left un-excavated until placing of concrete or masonry. This thickness shall be taken out just before the placement of concrete or masonry work.

In the event of over excavation without the approval of the Engineer, such over excavated area shall be filled with selected excavated or borrowed fill material approved by the Engineer and finished compacted.

Class C-5 concrete shall be used instead of selected material if instructed by the Engineer. All costs in connection with the fill of over excavation shall be borne by the Contractor.

Excess volume formed in excavation shall be filled with selected excavated or borrowed material approved by the Engineer and compacted to the compaction standard requirements in the Fill Section of the Specification.

The Contractor shall, when suitable bottoms to excavations have been reached report to the Engineer at least 24 hours before further work on excavated bottom is to proceed.

Any further work executed before obtaining the prior approval of the Engineer for the bottom of excavations shall be removed. New work shall be substituted only after the bottom of excavations is approved.

02312 Site Clearance

023121 Removal of bushes & vegetation

Site clearance shall be carried out in accordance with the direction of the Engineer for the area to be cleared. Bushes, vegetation and undergrowth shall be removed from sites required to be cleared. Trees and bushes shall be uprooted, raked and disposed off, deposited or burnt as directed by the Engineer. Holes left by stumps and roots shall be filled with suitable material and compacted to approval by the Engineer.

Site clearance shall be measured by area and shall be understood as including trees up to 80mm in diameter.

023122 Felling of Trees

Trees shall be up rooted, racked and disposed off or deposited as directed by the Engineer. Holes left by stumps and roots shall be

filed with suitable material and compacted to approval by the Engineer. Trees shall be enumerated and identified by diameter.

023123 Removal of termite hills

Termite hills shall be removed and disposed to appropriate tip. The cavity formed by the removal of termite hills shall be treated with termite proof solution as described in the "Termite Proofing" section of this Specification and filled with suitable material and compacted to the approval of the Engineer.

Termite hill removal shall be measured by the volume of earth removed and disposed off.

023124 Removal of structures

Temporary & permanent structures including substructure shall be demolished as indicated on drawings or directed by the Engineer. Voids formed by the demolition shall be treated as indicated in the drawings and specification.

Removal of structure shall be measured in lump sum, area or volume if sufficient description of works is given or using applicable units of work under each item of work in this Specification where unit rate quotations are required.

02313 Excavation & Get Out

023131 Removal of top soil

"Top soil" shall mean the top 200-300mm depth layer of soil containing more than 5% organic material by weight.

The top soil shall be removed to the specified depth leaving area clear off any vegetable soil. The removal of top soil shall be measured by the area occupied by the work to be placed on the cleared area. Removal of top soil shall be understood as including the disposal of surplus material or stock piling and wheel spreading of top soil at later stages as directed by the Engineer.

023132 Excavation in ordinary soil

"Ordinary Soil" shall mean material yielding to ordinary excavation machinery or pick axes. Excavation for ordinary soil shall be classified as Bulk excavation, Pit excavation and Continuous trench excavation.

Excavation shall mean the excavation and get out of the soil. Excavation in ordinary soil shall be measured by volume as the net void created by the excavation with deduction made for existing voids.

Excavation shall be measured in successive stages of 1500mm from starting level.

023133 Limits of Bulk Excavation

The limits of bulk excavation for the measurement shall be as shown on drawings. If not shown, the limits shall be, the surface area covered by the permanent structure resting on the area of bulk excavation plus the working space allowed for trench or pit excavations for the foundations of the permanent structure. In the instance of no limits being established or no permanent structure, the working space shall be determined by the Engineer but shall not

exceed 500mm on either side of the limits of the area to be excavated.

023134 Limits of Pit & Trench Excavation

Pit and trench excavation shall be measured by adding 250mm to each side of the dimension giving the surface area of the volume to be excavated.

The volume of excavation for masonry works buried in ground and requiring no foundation bedding shall be measured by the net volume of buried masonry & without allowing for any working space.

023135 Rock excavation

This section covers the excavation of soft and hard rocks and boulders.

"Soft Rock" shall mean weathered material, which can be excavated using excavators, tractor drawn tines, for breaking up the material.

"Hard Rock" shall mean material requiring the use of wedges, prismatic tools, blasting to enable the excavation work to be carried out.

"Boulder" shall mean isolated volume of hard rock in ordinary soil and soft rock or above ground less than 1/2 cubic meter in volume.

Rock excavation shall be classified into soft & hard rock and boulders. The excavation for rock shall be measured in successive stages of 1500mm. Excavation shall be classified into Bulk, Pit and Trench excavation.

In the instance of the use of explosive for blasting rock, the contractor shall fully comply with the requirement of the relevant Civil code and Condition of Contract applicable to the work being considered.

Explosives shall be used in the quantities and manner recommended by the Manufacturer.

Explosives shall be stored with separate compartments provided for detonators and shall be handled exclusively by experienced and authorized personnel only.

Permanent and temporary structure damaged by explosives shall be replaced at the cost of the Contractor.

The excavated hard rock is the property of the Investor and requires the approval of the owner and payment by the Contractor for its use.

Excavated hard rock shall be stock piled in a manner enabling measurement of the volume of rock for the purpose of payment for use by the Contractor.

The methods of measurement and working space allowance for "Ordinary Soil" shall be equally applicable to excavation in rock.

02314 Fill

023141 General

Fill to excavations or to make up level shall be made in suitable material approved by the Engineer and capable of being compacted.

Fill shall be placed in successive stages of not exceeding 200mm and watered and compacted to approval by the Engineer.

The compaction achieved in filling shall be measured in accordance with the standard practice. The In situ moisture content and density shall be compared with laboratory test results of modified AASHO T147 performed on samples of the selected material.

The minimum relative compaction to be achieved in the compacted area shall be 95% maximum dry density and the moisture content shall be within the range of 95% dry density. The moisture content of the fill material shall be adjusted as necessary to achieve the required compaction. Any material which after repeated compaction, does not fulfill the requirements, shall be removed and replaced.

The final levels of fill shall be adjusted, graded and prepared to receive bedding to be laid on fill. Fill shall be measured as equal to the net volume of void to be filled and shall be understood as including the stockpiling and haulage of material from location of fill.

023142 Classification of fill

Fill material shall be classified as: -

Backfill to excavation - Suitable material arising from excavation and capable of being compacted to form a stable filling having side slopes as indicated on drawing or directed by the Engineer.

Selected excavated fill - Suitable non expansive material approved by the Engineer arising for excavation and capable of being compacted to form a stable filling having side slopes as indicated on drawings or directed by the Engineer.

Selected borrowed fill - Suitable non-expansive well graded soil or granular material with no rock lumps imported from outside and approved by the Engineer.

02315 Disposal

All unsuitable and surplus suitable material arising from excavations shall be disposed off when instructed by the Engineer.

Disposal shall be made to tips directed by the Engineer or indicated in the document. In the absence of direction from the Engineer or indication in the documents, it is the contractor’s responsibility to identify the appropriate tip and dispose the material.

Disposal shall be understood to include stock piling, loading, transporting, dumping and wheel spreading at tip. Disposal shall be measured as the net volume arising from the void created by the excavation, less excavated material backfill, filled and wheel spread within site or left stockpiled.

02316 Sundry Items

023161 Termite proof solution

Termite proof measures shall be taken over the whole area of the buildings and aprons and shall consist of the application of a solution of 5 parts penthachlorpenol and 95 parts of furnace oil (by weight) well mixed together and applied by means of watering cans with fishtail spouts at the rate of 5 litters per m2. Before treatment the surface must be cleared of all rubbish and in particular scrap timber. The treatment shall be on the ground after removal of top soil and/or soft layer before making up levels.

Termite proof solution shall be measured in area over which it is applied.

023162 Gravel sub-base

Gravel sub-base shall be suitable approved by the engineer, crushed stone or naturally occurring gravel of specified size and finishing thickness laid on compacted fill or naturally occurring surface. The sub-base shall be well blinded to receive finish material.

Gravel surface shall be measured by the area of the surface on which it is laid.

023163 Hard core & stone filler

Hard core shall be sound approved stone of specified finishing thickness and placed as directed by the Engineer and finished blinded with 20mm crushed aggregate.

Hard core shall be measured by the area of the surface on which it is laid if the finished thickness does not exceed 300mm. Hard core and stone filling exceeding 300mm thickness shall be measured by the volume of void filled by the hard core or stone chipping.

The girths of sinking shall be taken as the surface area of hard core where such sinking occur.

023164 Dust blinding

Dust blinding shall be approved crushed stone dust from quarries for concrete aggregate production and shall be 50mm thickness finished true and level. Dust blinding shall be measured by the area of the surface on which it is laid.

023165 Slopes to embankments

"Slopes to embankments, cuttings, shoulders, ditches, etc., shall be trimmed to the dimension and inclinations shown on drawings. Excess material shall be removed. Depressions or voids that may be created during trimming shall be filled with the same material that is used to form the slopes and ditches.

Trimming of slopes shall be measured by length and shall be understood to cover the girth as detailed or specified in drawings or directed by the Engineer.

03 CONCRETE WORK

031 CAST IN PLACE CONCRETE

0311 DEFINITION

Cast in place concrete is concrete premixed at a batching plant and transported to the work site or concrete whose ingredients are transported to the site and mixed just before casting in place.

0312 GENERAL REQUIREMENT

03121 Work Included

Provide cement, aggregate, water admixture, labour equipment and tools for cast in place concrete as required for the satisfactory installation of the works.

0312 Related Works Described Elsewhere

Excavation and Earth Work	Section	02
Formwork	"	032
Reinforcing steel	"	033
Precast concrete	"	034
Precast ancillaries	"	035

03123 Quality Assurance

031231 Standards

Comply with the following standards.

ES C. D5 201	General Requirement, Portland cement,
ES C. D8 490	Methods of Sampling and testing Portland cement, ESI
ES C. D3 201	Normal Concrete aggregate, ESI
ASTM C260	Air-entraining admixtures,
ASTM C494	Water-reducing, retarding and accelerating admixtures.
ASTM C94	Mixing water for concrete.
ASTM C330	Light weight aggregate for structural concrete

031232 Qualification of Workmen

Generally comply with the requirement of qualification of workmen in the workmen section of the general requirements of this Specification.

In addition to these requirements, assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the works of this section.

031233 Submittals

Submit manufacturers test certificates, with the consignments or as directed for cement. Prepare samples and carry out tests for concrete and materials as directed by the Engineer and as specified under the Testing Section of this Specification.

031234 Product Data

Submit product data for approval immediately after signature of contract indicating the following: -

Source of cement, aggregate, mixed concrete and admixtures.

Manufacturer's name, and place of manufacture for cement, and ready mixed concrete and admixtures. Manufacturers' certificate showing properties of cement precast elements & admixture.

Laboratory test results showing properties of aggregate and ready mixed concrete.

Proposed equipment for and methods of sampling and testing materials on site or nearest laboratory.

031235 Compliance

Comply with the general submittal, substitution and sampling sections of the General Requirements of this Specification.

03124 Delivery and Storage

CEMENT: Cement shall be stored in bags or containers in an enclosed, ventilated space that would protect it from deterioration. Cement shall always be stored off the ground. The off the ground formation method shall be subject to approval by the Engineer. Different types and consignments of cement shall be stored distinctly separated and with markings showing the type and date of consignment.

AGGREGATES: Aggregates shall be stockpiled on clear hard surface to prevent contamination by other material and to avoid segregation. Different grades of aggregate shall be stocked independently, sufficient distance being maintained, to avoid mixing during unloading and use.

Tests for compliance with the requirements of grading & cleanliness may be carried out if required by the Engineer, on samples taken from the points of stockpiling or batching.

Stockpiles of aggregate shall be allowed to drain to ensure relatively uniform moisture content thorough out the stockpile. Suitable means shall be provided in hot weather to shield the aggregate stockpiles from the direct rays of the sun.

WATER: Water for concrete mixing and curing shall comply with the requirements of ASTM C94. Water shall be piped or otherwise stored in an enclosed container free from contamination.

ADMIXTURES: Admixtures shall be stored in such a manner as to avoid contamination, evaporation or damage.

Agitation equipment shall be used to ensure thorough distribution of the ingredients of non-stable or suspension solutions of admixtures. Liquid admixtures shall be protected from temperature changes that would adversely affect their characteristics.

03125 Protection

Protect material and concrete from inclement weather and damage by work on other trades.

03126 Replacement

In the event of damage before and after installation, replace or rectify at no additional cost to the Investor.

03127 Concrete Testing

031271 Cube tests

Test cubes for anyone structure, shall be prepared by the same person all the time. Samples shall be made or any one structure, at the same time from the same batch of concrete about to be placed in the structure. A slump test shall be made from the same sample. Test cubes shall be made as and when directed by the Engineer; but not less than one set of nine cubes shall be made for each 100m3 of concrete placed, or if the rate of placing is less than 100m3, then each 10 days or every floor for multi-storey structures.

Three cubes of each set shall be tested at 3 and 7 or 7 and 14 days and the third at 28 days all in accordance with the Code of Practice, ASTM, BS, or ESI test methods. Upon delivery of each new consignment of cement or other change of material or proportion, nine extra cubes shall be made and tested.

Cubes shall be clearly marked and dated as instructed. An accurate record of the location of the concrete for which the test is ordered shall be kept.

031272 Structural Test

If there is any doubt as to the strength of a structure solely or in part of the reasons that the site made concrete test cubes fail to attain the specified structure, strength, or because of one or more circumstances attributable to collapse or negligence; loading. Test shall be made in accordance with CP 2.

031273 Material Tests

Aggregate shall be, tested in accordance with the requirements of the standard for the suitability for concrete works. Aggregates shall be tested as often as change in source is made or directed by the Engineer.

03128 Dimensions and Tolerances

Except where specially noted, dimensions, tolerances, sizes, positions, and concrete cover to reinforcement shall be as dimensioned in the drawings with the following tolerances: -

Tolerance for the dimensions of concrete section (total depths of a beam or lab, breadth of a beam or web thickness, dimensions of column section):

Delta 1 = 0.051 for 1 400mm
Delta 1 = 20 mm for 1 400mm

Tolerances for effective depths:

Delta 1 = 0.751 for 1 200mm
Delta 1 = 0.51 + 5mm for 200 1 400mm
Delta 1 = 25mm for 1

Tolerance on minimum concrete cover:
Delta 1 = ±5mm

Deviation of the dimension of a section from those indicated in drawings shall not exceed the lesser of ±2% ±50mm greater accuracy than ±10mm is however, not required.

Permanent horizontal size curvature of a member shall be less than 0.2% of the span.

Levels of floor slabs, beams lintels, etc. intended to be horizontal must not slope more than 6 mm in 3 meters.
Errors in plumbing to be not more than plus or minus 6mm and no line intended to be straight and vertical shall slope more than 6mm in 3 meters.

0313 PRODUCTS

03131 Materials for Concrete

031311 Cement

Cement shall be "Ordinary Portland or Portland Pozzolana" manufactured by an approved firm and shall comply in all respects with the requirements of ES C.
D5. 201.

"Rapid Hardening Portland cement" may be used, subject to prior approval by the Engineer in order to speed up the progress of the works.

Cement shall be used in the order delivered. It shall be visually checked and tested before being used. Set or partially set cement bags shall be immediately removed from the site.

If required, manufacturers test certificate for each consignment of cement, shall be issued with the consignment. Further tests for fineness and compressive strength for consignment already delivered shall be made when required by the Engineer.

The cement content of a concrete mix shall correspond to the mix proportion indicated under the Class of concrete of this Technical Specification.

031312 Aggregate

FINE AGGREGATES: Shall be natural or crushed gravel or stone, clean sharp coarse grit, pit or river sand to conform with the requirements or ES C. D3. 201 for concrete aggregates.

COARSE AGGREGATE: Shall be hard clean gravel or broken stones, durable, non-porous and free from harmful matter. It shall conform to the requirement of ES.C. D3. 201.

Aggregate for lightweight concrete shall confirm to the requirements of ASTM 330.

Samples of concrete aggregate materials shall be submitted for testing at least two weeks before bulk deliveries of aggregates are made. No deliveries in bulk shall be commenced until samples are approved.

Rejected samples shall be removed from the site within 24 hours.

Aggregates shall be obtained from an approved source. Samples of aggregates shall be supplied for approval, and when approved, further deliveries shall conform to the approved samples. Any material considered to be inferior to the approved samples shall be condemned and removed from the site. Aggregate shall be washed as often as required to make it conform to this Specification.

Fine and coarse aggregates shall be regarded as separate ingredient if not delivered like wise. Where more than one sizes of aggregate are combined with concrete mix, such proportion of combination shall confirm to the appropriate grading as established by tests or as directed by the Engineer.

031313 Water

Water for concrete shall confirm to the requirements of ASTM C94.

Water shall be from an approved source and shall be clean, free from oil, acid, alkali, or any vegetable or organic matter harmful to any material with which it is used.

If available drinking water piped supply shall be used.

031314 Admixtures

Admixtures to be used for concrete when permitted by the Engineer shall confirm to the requirements of ASTM C260 & ASTM C494. Admixtures used in the work shall be of the same composition as used is establishing concrete proportions for the required class of concrete.

03132 Concrete

031321 General

Concrete for the works shall be the specified class obtained from the mix proportion as indicated in the "Standard mixes for ordinary Structural Concrete" of this Specification or as established by tests.

Concrete shall be capable of being placed without segregation. It shall when cured develop the strength and appearance as required by the Specification.

031322 Mix Proportion

The proportion of concrete ingredients given in the "Standard mixes for ordinary Structural Concrete" of this Specification or proportions obtained by tests shall be used for concrete mixing.

The proportion of ingredients shall be such as to produce a mixture, which will work readily into the corners and angles of the forms and around reinforcement with out segregation of the material

components. Where the proportion of ingredients given in the Concrete Class Section of the Specification is not applicable, trial batches shall be made and the mix from which the desired strength is established by testing shall be used for the works.

031323 Gauging and Mixing

Ready mixed concrete shall be batched, mixed and transported in accordance with ASTM C94.

Concrete produced by on site batching and mixing shall conform to the requirement hereunder. Measurement of volume of aggregate shall be made in impervious gauge boxes or containers of accurate size, to a predetermined uniform depth without compacting. The measurement of aggregates by weight shall be made in an approved weight batch. The weight of aggregates shall be as to produce the same mix as produced by volume batching.

Allowance for the water content of the aggregates must be made. The concrete shall be mixed in an approved mechanical batch mixer. Mixing shall continue until there is a uniform distribution of the materials and the mass is uniform in colour and consistency but in no case shall the mixing continue for less than two minutes after adding water. The volume of concrete in any batch shall not exceed the rated capacity of the mixer.

Concrete shall be proportioned and produced to have the limits of slump as shown in the Concrete class section of this Specification." The slump may be varied from the limits as given in the Specification provided approval for such variation is given by the Engineer.

Hand mixing of concrete shall not be done. If the situation makes hand mixing unavoidable, the cement content of the concrete in the mix shall be increased by 10%.

The whole of the mixed batch shall be removed before materials for fresh batch enter the mixer. On cessation of concreting, including all stoppages exceeding 20 minutes, the mixer handling plant and tools shall be washed with water.

Mixed concrete shall not be modified by the addition of extra water or cement or otherwise, in order to facilitate handling or for any other purpose. Additives to improve workability may be used only with prior approval.

The consistency of the concrete shall be controlled by direct measurement of the water content, making allowance for any water in the aggregate. The limits to slump as given in the concrete class section of this Specification shall be used for control purposes.

Admixtures shall be used as directed by manufacturers.

Aggregates in hot weather shall be sprayed with water before mixing to ensure that, the temperature of the aggregate and water mix does not exceed 32 degree centigrade.

031324 Proposed mix proportions

The following are the proposed mix proportions to produce concrete per 50kg cement and arrive at the required strength. It is the responsibility of the contractor to produce the appropriate mix design using the proposed proportion or trial mixes and tests to achieve the required strength.

Concrete containing less cement than that prescribed below may be used if it is established by tests that the required compressive strength is achieved and demonstrated that the concrete produces required finishing properties, durability and surface hardness. The reduction of cement content shall require the specific approval of the Engineer.

0314 EXECUTION

03141 Transporting

Concrete shall be handled from the place of mixing to the place of final deposit as rapidly as practicable by methods, which will prevent segregation or loss of ingredients. It shall be deposited as near as practicable in its final position to avoid re-handling or floating. When chuting is used the inclination of the chute shall be such as to allow the concrete to flow without the use of water in excess of the specified volume for mix and without segregation or loss of the ingredients. Details of any proposed chuting plant must be approved before the plant is delivered.

03142 Placing and Consolidation

Formwork shall be completed reinforcement, expansion joint material, anchors, block outs add other embedded items shall be placed in position before concrete is cast.

No concrete shall be placed until the reinforcement and formwork have been checked and approved.

The method and equipment used for casting concrete shall be approved by the Engineer.

Concrete must be placed before setting has commenced and must not be subsequently disturbed. Concrete shall be thoroughly worked around reinforcement and embedded around fixtures and into corners of the formwork.

Tampers of approved types shall be used. Mechanical vibrators of approved patterns shall be used wherever possible and especially in all precast work. The consistency of the concrete shall be maintained correct for mechanical vibration and the vibration must not be carried out too long to cause separation of materials and bring cement laitance to the surface. Poker type vibrators shall not be allowed to lie unattended in concrete while switched on, nor shall any vibrating equipment be used for spreading concrete. No concrete shall be dropped during placing from a height exceeding two meters, unless special methods of consolidation of the concrete are approved. The methods shall be such as not to displace the reinforcement. After being placed in position, the concrete must be left absolutely undisturbed by any movements or thrusts while setting. An accurate record must be kept showing dates and items when various portions were cast.

Concrete shall be cast continuously and when in layers, the fresh concrete shall be cast before the under layer has hardened. Construction joints as approved or directed by the Engineer or provided in the drawings shall be placed if concrete cannot be cast continuously.

Wherever waterproof concrete is cast, it shall be compacted by mechanical vibration, so that a dense and homogeneous mass of concrete is obtained throughout every part of the structure. Waterproofing additive directed to be added to the mix shall be applied in shall be so constructed to achieve full continuity. Structures required to be constructed in waterproof concrete shall be completely watertight and any work found to be defective shall be made good by pressure grouting or otherwise as instructed by the Engineer.

In hot dry weather suitable means shall be provided to avoid premature stiffening of concrete placed in contact with hot dry surfaces. Where necessary the surfaces including reinforcement, against which concrete is to be placed shall be shielded from the direct rays of the sun and shall be sprayed with water to prevent excessive absorption by the surfaces of water from the fresh concrete.

03143 Bonding

The hardened concrete of construction joints and joints between concrete structures shall be dampened and thoroughly covered with a coat of cement grout in the same proportion as the concrete mix proportion to be used. The fresh concrete shall be cast before the grout has attained its initial set.

03144 Finish to concrete surfaces

Concrete surfaces where formwork is in contact with the face of concrete shall be finished as required in the formwork section of this Specification.

Where no formwork is in contact with the concrete surface, the surface shall be finished in either of the following ways as indicated in the drawings or directed by the Engineer.

Trowel finish to be applied to slab surfaces exposed to view and surfaces to be covered with resilient flooring, carpeting, paint or other thin floor coating. Trowel finish shall be done using power driven trowel. The final trowel shall be hand made and left free from trowel marks. The surface plane tolerance shall not exceed 3mm in 3 meters height. Surface defects which would telegraph thorough applied flooring shall be ground off.

Floating shall be machine or hand operated depending upon the convenience of the area to be floated. High area shall be cut and low areas filled and the surface floated to produce a smooth, uniform feature.

Where non-slip brown finish is to be applied, the concrete surface shall be slightly roughened immediately after trowel finish by brooming in the direction perpendicular to the main traffic using a fiber bristle broom.

Where scratch finish is to be applied, the concrete surface shall, after leveling be scratched using stiff broom or brush for surfaces to receive bond applied cement based finish material.

Where bust hammer finish is to be applied, the concrete surface shall be pooled with a power driver hammer or manually to expose aggregate as directed. Care shall be taken to preserve arises. The surface shall be wire brushed and washed down on completion.

03145 Curing & Protection

Concrete shall be protected from premature drying and excessively hot temperatures for at least 28 days from the date of casting. The concrete surface shall be kept continuously wet by application of water for at least 7 days to maintain constant temperature. The watering of concrete shall continue until the concrete has achieved its designed strength. Where the temperature is excessively high the surface of concrete shall be covered with absorptive mat, fabric or sand continuously kept wet or the application of other moisture retaining covering as approved by the Engineer.

Where the surface of concrete is covered with formwork, the surface of the form shall be wetted until removed.

0315 Methods of Measurement

03151 Insitu concrete work shall be understood as including gauging, mixing, casting in place, construction joints tamping of horizontal surfaces and curing.

03152 Differentiation shall be made for: -

- Plain & reinforced concrete
- Below and above grade work
- Classes of concrete
- Foundation
- Columns
- Ground & suspended beams & lintels
- Ground & suspended solid & ribbed slabs.
- Walls
- Steps, staircases and landings
- Mass in-fillings.
- Grouting & filling to holes.
- Other concrete works.

03153 Measurement

Cast in place concrete shall be measured by volume except for the following: -

- Ribbed slabs measured by area stating thickness.
- Grouting and filling to holes shall be enumerated stating sizes.

03154 Deduction

No deduction shall be made for voids up to $0.25m^2$ in area.

032 CONCRETE FORMWORK

0321 DEFINITION

Formwork shall mean temporary support construction for in-situ concrete, designed and constructed in timber or metal and capable of withstanding the live and dead loads imposed on it and fully preventing leakage of concrete.

0322 GENERAL REQUIREMENT

03221 Work Included

Provide formwork timber, steel, shores, wedges, nails, labour & tools for formwork as required for the satisfactory construction of formworks.

03222 Related Work Described Elsewhere

Cast in place concrete	Section 031
Reinforcing Steel	" 033
Precast Concrete	" 034
Concrete Ancillaries	" 035

03223 Quality Assurance

032231 Qualification of workmen

Generally comply with the requirement of qualification of workmen in the workmen section of the General Requirements Section of this Specification.

In addition to these requirements, assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the works of this section.

032232 Submittals

Prior to construction of formwork, submit details of materials, proposed construction methods and formwork design calculations for the approval of the Engineer.

032233 Compliance

Comply with the general submittal, substitution and sampling section of the General Requirements Section of this Specification.

032234 Formwork Design

Formwork shall be designed and erected to safely support, vertical and lateral loads that might be applied until such load can be supported by the concrete structure.

Vertical and lateral loads shall be carried to the ground by formwork and in place construction that has attained adequate strength for the purpose.

Formwork and false work shall be designed to include assumed value of live loads, dead load, weight of moving equipment operated on formwork, concrete mix, height of dropping concrete, vibrator frequency, ambient temperature, and other factors pertinent to safety of structure during construction.

03224 Delivery & Storage

Formwork material shall be delivered to the site immediately after taking over the site. Formwork timber and panels shall be open stacked in an off the ground position. Timber for formwork shall be stored under shed.

Timber and panel formwork for reuse shall be cleaned, oiled & stacked.

0323 PRODUCT

Formwork material shall be sawn board reasonably straight grained, plywood or metal panel the use of which shall be determined in compliance with the type of surface finish required.

0324 EXECUTION

03241 General

Forms shall be used, wherever necessary to confine the concrete and mould it to the required dimensions and shapes.

Forms shall be sufficiently tight to sustain loss of liquid from the concrete. Backup material at joints to prevent leakage and fins shall be provided as required. Formwork material shall be of sufficient thickness to withstand pressure of newly placed concrete, all dead, live, self and superimposed load.

Form coating compounds shall be those that do not stain bond or adversely affect the concrete or curing.

03242 Preparation

Rubbish, particularly wire off-cure, chipping, shaving and sawdust, shall be removed from the interior of the forms before concrete is placed. Washout holes shall be provided to facilitate cleaning. Formwork surfaces in contact with concrete shall be cleaned and thoroughly wetted and treated with approved non-staining mould oil or other composition. Approved mould oil or composition shall be kept out of contact with the reinforcement and shall be used as separately as possible.

03243 Formwork Construction

Forms shall be constructed to the exact sizes, shapes lines and dimensions shown and as required to obtain accurate alignment, location grade, level and plumb work in finished structures. Provision shall be made for openings, offset, sinking, keyways, recesses, moldings, reglets, chamfers, blockings, screeds bullheads, anchorages, inserts and other features as required.

Forms for openings, and construction which accommodate installation by other trades whose materials and products must be fabricated before the opportunity exists to verify the measurements of adjacent construction which affects such installations, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved, without additional expense to the Investor.

Forms shall be fabricated for easy removal without hammering or praying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

Temporary openings shall be provided where interior area of formwork is inaccessible for, clean out, in section before concrete placement, and placement of concrete.

Brace temporary closures and set tightly to temporary openings on forms in as inconspicuous locations as possible, consistent with design requirements.

Shores and struts shall be provided with positive means of adjustment using wedges, jacks or other appropriate means, capable of taking up formwork settlement during concrete placing operations. Truss supports shall be used where adequate foundation for shores and struts cannot be secured.

Form facing materials shall be supported by structural members spaced sufficiently close to previous objectionable deflection.

Cambers in formwork shall be provided as required for anticipated deflections due to weight and pressure of fresh concrete and construction loads. Forms shall be fitted in successive units for continuous surface to accurate alignment, free from irregularities and within allowable tolerances.

Formworks shall be constructed to produce concrete in the dimensions shown in drawings and within the limits of tolerance allowed in the Cast in place concrete section" of this Specification.

Side footings of forms may be omitted and concrete placed directly against excavation if approved by the Engineer. If omitted a minimum additional coverage of 50mm of concrete of the same quality shall be provided on each side.

03244 Formwork Removal

No undue deflection or damage whatsoever shall be caused to a structure by the removal of formwork. In no circumstances, shall formwork be struck until the concrete attains a cube strength of at least twice the stress to which it may be subjected at the time of striking. No formwork shall be removed until the concrete has hardened sufficiently.

Concrete which is damaged by premature removal or collapse of the formwork shall be made good. Formwork shall be removed without such shock or vibration as would damage the concrete. Before the soffit formwork and struts are removed, the concrete surface shall be exposed where necessary, in order to ascertain that the concrete has hardened sufficiently.

PERIOD OF REMOVAL:

Vertical formwork to columns, walls & beams	16 hours
Soffit formwork to slab	21 days
Propos to slabs	14 days
Soffit formwork to beams	21 days
Props to beams	14 days

03245 Formwork classification

032451 Normal finish formwork

Formwork material for concrete concealed from view or to be finished covered with other material shall be sawn board reasonably straight grained to provide mechanical bond for subsequent application of finish.

After removal of the formwork the face of the exposed concrete shall be rubbed down immediately to remove fins or other irregularities. In the event of parts of the concrete being honeycombed, such portions shall be cut out to required depth and shape and made up with concrete of approved quality. The face of the concrete for which formwork is provided, other than those against which back fill or further concrete or other material is to be placed to conceal the face of the concrete shall be smoothed with a wooden float to give formwork is provided.

Faces of concrete intended to be plastered or rendered shall be made good, and hacked or treated with a bonding agent to form satisfactory adhesion for render or plaster.

032452 Fair Face Concrete Formwork

Formwork for exposed concrete surfaces to be finished fair faced shall be plywood, metal or other panel material to provide continuous, straight, and smooth as cast surfaces. Panel sizes shall be as large as practicable to minimize joints.

Where so directed faces of concrete shall be finished fair by means of wrot formwork, to produce a true surface and shall have all imperfections in the concrete face cut out and made good in cement mortar to match the texture and colour. The concrete shall be rubbed down with carborundum stone, dipped in cement grout to finish clean and smooth to a high standard, without trace of shuttering marks, joints or other disfigurements.

032453 Patterned Concrete Formwork

Formwork for patterned concrete surfaces shall be for fair face finish in plywood, milled timber boards metal or other panel material to provide straight, smooth as cast surfaces as specified or directed.

Patterned finish shall be formed with approved wrought boards of specified nominal width, having exposed grain and being arranged as shown on the drawings.

Boards shall be of adequate thickness and be jointed with groove and loose tongues. End of board jointing shall be tongued and grooved staggered and well distributed. The edges of boards shall have a nominal 2mm chamfer to form controlled fins.

The resulting concrete shall clearly show grain. Individual board marks shall be free from honeycombing and excessive air holes and shall be of uniform colour.

0325 Methods of Measurement

03251 The measurement for formwork shall be understood as including: -

- Construction and removal of formwork
- Making good of concrete honeycombs.
- Making good of concrete surfaces to attain the standard of finish desired by the specified type of formwork.
- Angles & returns.

03252 Differential shall be made in formwork for: -

- Below and above grade work.
- Work exposed to view & buried work.
- Work on which further finish is to be applied
- Formwork to produce architectural concrete by specifying desired type of finish.
- Footings
- Columns
- Grade & below grade beam.
- Suspended and on wall resting beams.
- Solid slab
- Ribbed slabs
- Walls
- Staircase, steps and landing.
- Grouting, in filling & block outs.
- Other concrete works.

03253 Measurement

Formwork shall be measured by area, taken as the net area in contract with the finished face of concrete with no allowance made for passing at angles, overlaps and intersections.

03254 Deduction

No deduction shall be made for voids in form work up to $0.25m^2$ in area.

033 REINFORCEMENT

0331 DEFINITIONS

Reinforcement work shall be understood as the supply and fixing of reinforcement bars, including ties and chairs.

0332 GENERAL REQUIREMENT

03321 Work included

Provide reinforcing bars, welded fabric reinforcement, tie wire, chairs, labour and tools for the satisfactory placement of reinforcement works.

03322 Related works described elsewhere

Cast in place concrete	Section	031
Concrete formwork	"	032
Precast concrete	"	034
Masonry works	"	04

03323 Quality Assurance

033231 Standards comply with following standards.

ES. C. D7.101	Mild steel reinforcement ESI.	
CP : 1	Ministry of Construction	
CP : 2 part 1	"	"
P : 3	"	"

033232 Qualification of workmen

Generally comply with the requirement of qualification of workmen in the Workmen Section of the General Requirements of this Specification.

In addition to these requirements, assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the works of this section.

033233 Submittals

Submit manufacturer's certified test date showing the following characteristic for reinforcing bars and wires for approval by the Engineer prior to placing order for reinforcement.

- Ultimate tensile stress
- Yield point stress
- Elongation
- Cold bend test

In the instance that certified test data is not issued, tests shall be made to verify the above properties. The criteria for the acceptance of the above test results shall be those required by ES. C. 07.101.

03324 Delivery & Storage

Reinforcement shall be delivered in sufficient quantities prior to start of concrete work, to ensure that no constructed formwork lies idle and exposed to weather due to reinforcement not being placed in position.

Reinforcement shall be stored in an off the ground position to prevent rust by contact with soil, dampness and other objectionable materials.

0333 Execution

03331 Preparation

Formwork and conditions under which reinforcement is to be placed shall be examined and corrected prior to the placement of concrete.

03332 Tolerances

The cover to reinforcement as shown in the Cast in place Section of this Specification shall be maintained.

03333 Placement

The placement of reinforcement and supports shall comply with the requirements of the Standards and Codes of Practice.

Reinforcement shall be cleaned to remove loose rust and mill scale, earth, loose rush, oil, grease and other material which are likely to reduce bond with concrete.

Reinforcement shall be secured against displacement by formwork construction or concrete placement. Reinforcement shall be supported by metal chairs, runners or concrete spacers meeting the required concrete cover thickness.

Reinforcement bars and supports shall be tied in 1.6mm mild steel wire. The bars shall be accurately placed as shown on drawings and their positions maintained during all operations.

Splices shall be provided by lapping ends, placing bars in contact and tying tightly with wire.

Fabric reinforcement shall be laid as long as practicable and joints lapped at least one full mesh.

No concrete shall be cast until reinforcement has been checked and approved by the Engineer.

0334 METHODS OF MEASUREMENT

Reinforcement work shall be understood as including cutting, bending, placing in position, tie and spacers.

Reinforcement shall be measured by the net weight of the bars & set in position with out allowance for ties and spacers.

Allowance shall be made for overlaps only if indicated on drawings & schedules or at overlaps of bars where the length of the bar reaches the maximum standard production limit.

The unit weights of reinforcement bars shall be the official unit weight issued by the appropriate Ethiopian Authority.

034 PRECAST CONCRETE

0341 DEFINITION

Precast units shall be understood as plain or reinforced concrete units set in moulds, cured and fixed in position as detailed on drawings.

0342 GENERAL REQUIREMENT

Comply with the general requirements, and products section of the following.

Cast in place concrete	Section	031
Concrete formwork	"	032
Reinforcement	"	033

0343 EXECUTION

03431 Samples of Precast Units

Before fabrication in bulk, specimen samples of the precast units shall be submitted for approval, with which further deliveries or castings shall be compared for uniformity of colour and finish.

03432 Casting

Precast concrete shall be concrete as specified and shall be thoroughly compacted by vibration in the moulds and shall not be removed from them until seven days after placing the concrete. The sides may be removed after three days provided that the moulds are such that the sides are easily removable without damaging the concrete.

Precast work shall be cast under sheds and shall remain three days in the moulds and a further seven days after removal from the moulds. During the whole of this period the concrete shall be shielded by sacking or other approved material kept wet. It shall then be removed from the sheds and stacked in the open for at least seven days to cure.

Unless specific dimension are given, precast work shall be cast in lengths convenient for handling. The precast units shall have adequate strength to resist over stressing and damage during handling and erection. Care shall be taken to ensure that the units are not chipped or damaged.

Architectural, structural and services drawings shall be examined to determine dimension and location of holes.

Permission to form holes in precast units after casting shall not normally be given, but in exceptional cases where the structural soundness of the perforated unit and its visual acceptability is satisfactory such permission may be given by the Engineer in writing.

Precast units shall be clearly marked immediately after casting or demolishing, showing the identification of the unit and, if necessary erection instruction. The marking is to be such as to be invisible after erection.

03433 Erection

Precast units shall be hoisted placed in proper position and tied in such a way as to avoid over stressing or damaging the units nor causing damage to previously erected structure. Where shown the units shall be laid on thin bed of cement in order to even out irregularities of supporting members.

0344 Methods of Measurement

Precast units shall be understood as including moulds, concrete, reinforcement, placing in position and finishing face of units.

Precast units shall be measured by length or enumerated stating sizes.

035 CONCRETE ANCILLARIES

0351 DEFINITION

Concrete ancillaries shall include expansion joints in fiber board, plastic material & plastic, metal and other water stops, permanently or temporarily embedded in concrete.

0352 EXPANSION JOINTS

Where shown, expansion joints shall be formed between the concrete faces, or between concrete and other adjacent work, by means of incorporating in the formwork an approved impregnated fiberboard or other filler to the thickness shown on the drawings.

The Exposed edges of expansion joints shall be sealed. Filler boards shall be adequately wound into adjoining concrete to prevent their falling out when the joint opens.

In-situ ground slabs laid on backing material shall be cast in bays not exceeding 40m2 in area. The layout of construction joints in the slab shall be approved in advance. Fabric reinforcement shall be so arranged that laps shall occur along the joints as detailed on drawings.

Steps necessary, such as sealing of joints shall be taken to prevent escape of grout which would lead to staining of brick, stone, block works and exposed concrete surfaces when the in-situ topping is laid.

0353 WATER STOPS

The material, sizes and location of water stops in concrete joints shall be as detailed in drawings.

Water stops shall be as long as practicable to ensure that end joints are reduced to the minimum.

Water stops shall be overlapped, welded or fixed otherwise at end joints, in order to attain the water tightness and flexibility required by the continuous section of the water stop material.

0354 OTHER EMBEDDED MATERIALS

Embedded materials to form ties for other adjacent work, block outs for service pipes, conduits and anchors shall be placed prior to concreting.

Embedded materials shall be accurately placed and set secure in position in order to ensure that no cutting of concrete is required after casting and the embedded items are protected against displacement.

Precaution shall be taken in removing embedded materials after concreting if such items are required to form block outs.

Grouting to temporary opening after placement of anchors, pipes, etc., shall be done in the same class of concrete as used for the concrete work under consideration.

0355 METHODS OF MEASUREMENT

Expansion, materials, water stops, block outs, etc shall be measured in length or enumerated stating sizes and understood as including removal if material is placed as temporary measure only.

04. MASONRY WORKS

041 DEFINITIONS

0411 Below grade wall shall mean masonry to the level of ground floor whether slab is resting on ground or suspended.

0412 Above grade wall shall mean masonry above ground floor.

0413 Buried wall shall mean masonry in contact with earth on both faces.

0414 Tapering wall shall mean wall built at specified inclination from the vertical.

0415 Cavity wall shall mean wall built with air space of given width between the two faces of the wall.

042 GENERAL REQUIREMENT

0421 WORK INCLUDED

Provide all masonry material, mortar, and tie as indicated on drawing and specified herein, and labour, equipment, tools, scaffolding for masonry works, as required for the satisfactory installation of the works.

0422 RELATED WORKS DESCRIBED ELSEWHERE

Cast in place concrete	Section	031
Reinforcement	"	033
Plastering and pointing	"	111
Floor and wall finishing	"	112

0423 QUALITY ASSURANCE

04231 Standards

Comply with the following standards.

BS1232	Natural stone for building, BS
ES CD4 001	Solid clay bricks, ESI
ES CD4 026	Hollow clay bricks, ESI
ES CD3 301	Concrete hollow blocks, ESI
ES CD5 201	General requirements, Portland cement, ESI.
ES CD5 003	Hydrated lime, ESI
BS 1200	Sand for mortar for plain and reinforced brick work; brick walling & masonry, BS.
ASTM C94	Mixing water for concrete

04232 Qualification of Workmen

Generally comply with the requirements of qualification of workmen in the general requirements of this Specification. In addition to these requirements, assign at least one person for each type of masonry work who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the work of this section.

04233 Submittals

042331 Product data

Submit product data for approval by the Engineer immediately after signature of contract, indicating the source of cement, lime, aggregate, stone, brick & blocks and manufacturers certificate showing properties of cement and lime. Samples of stone not less than half percent of the consignment and not smaller than 450mm long to show all natural variations such as colour, texture and specified finishes shall be submitted to determine suitability and approval by the Engineer.

Submit samples of brick & block not less than one per thousand of each type of brick & block consignments. The samples shall show colour, texture, evenness of edges and accuracy of dimensions to determine suitability and approval by the Engineer.

Rejected samples shall be removed off site immediately upon receipt of such instruction by the Engineer.

042332 Submit manufacturers' test certificates with the consignment or as directed by the Engineer for cement and lime and factory produced brick and blocks.

Carry outs tests for bricks & blocks when no certificate is available to verify their compliance to the required standards.

A minimum of six bricks or blocks from each type shall be tested from each consignment of not more than 4000 or a minimum of six blocks per 4000 for site produced blocks. Samples shall be selected at random from the consignment delivered or those produced on site.

042333 Compliance
Comply with the general submittal; substitution and sampling section of the General Requirements section this Specification.

0424 DELIVERY & STORAGE

Comply with the requirements of the delivery & storage of cement and aggregate in the Insitu cast concrete section of this Specification for the delivery of cement, bagged lime and aggregate for masonry works respectively.

Bricks and blocks shall be unloaded and handled in a manner to prevent, soiling chipping and other damages rendering the material unusable for the intended purpose. Bricks and block shall be stacked on clean & dry level hard standings and shall be protected against contamination.

043 PRODUCTS

0431 STONE FOR MASONRY

Stone obtained from quarries approved by the Engineer shall be hard & sound, free from vents, cracks, fissures, discoloration, or other defects that will adversely affect strength or appearance. Stone chips out of which shaped stone are to be produced shall not be less than 450mm average and 380mm individual length.

Stone for various masonry works shall be selected and shaped as follows: -

- Stone for facing work shall generally be selected for consistency in grain, colour, and texture through out the work.

- Stone for below grade work concealed from view shall be chiseled natural stone average size 450mm.
- Stone for rough dressed exposed faces shall be fair chiseled and in average 450mm and individual not less than 380mm length.
- Stone to receive other finish shall be chiseled natural stone in average 450mm and individual not less than 380mm.

The exposed face for dressed stone masonry shall be dressed to the sizes and textures as shown in drawings or directed by the Engineer.

0432 BRICKS

Bricks shall comply with the requirements of ES CD 4026 and ES CD 4001.

Bricks shall be well made and adequately burnt. Bricks shall be free from deleterious and injurious substances and particles of lime.

Bricks shall be selected for their consistency in dimensions, shapes, angles and strength.

Bricks exposed to weather shall in addition to the above requirement be selected for least absorption and high durability.

Exposed bricks for facing work shall in addition to the above requirements be selected for consistency in colour and texture.

0433 HOLLOW & SOLID CONCRETE BLOCKS

04331 Manufacture and Curing

Concrete blocks shall be obtained from an approved supplier or may be manufactured on site. Samples and test results shall be submitted for approval by the Engineer before any blocks are delivered or used in the construction of the works.

Blocks shall be manufactured from cement and aggregates complying with the requirements of ES CD3 201, and/or pumice with no fine volcanic dust.

The Contractor shall prepare design trial mix using the available materials to give the average minimum compressive strength as specified in the compressive strength requirements of this section after casting and curing of 28 days. A minimum of 9 blocks shall be prepared from this mix for testing.

Blocks shall be uniform in texture, shape, size, with sharp arises and free from any cracks or defects.

Blocks shall be produced under shed on a suitable smooth floor.

Only machines of approved design shall be used for the manufacture of blocks.
Blocks shall remain under shed and wet cured for a minimum of 7 days after casting.

The surface characteristics of blocks shall be such that a good key for plaster or render is provided where required. Blocks shall not leave their place of manufacture before the age of 28 days.

04332 Compressive Strength of Blocks

The following are the minimum compressive strength requirements for blocks at the age of 28 days. The mix proportions of the material components are to be adjusted as required to obtain the required compressive strength.

043321 Hollow block

Class	Average of 6 Blocks	Individual Block
Class A	42kg/cm2	38kg/cm2
Class B	35kg/cm2	32kg/cm2
Class C	20kg/cm2	18kg/cm2
* Class AA	70kg/cm2	65kg/cm2
* Class AAA	50kg/cm2	46kg/cm2

Class AA is for load bearing wall below grade
Class AAA is for load bearing wall above grade

043322 Solid blocks

Class AA 120kg/cm2 load bearing below grade
Class AAA 85kg/cm2 load bearing above grade

0434 ADOBE

Adobe shall be prepared of clay with a possible minimum amount of drying shrinkage. It shall not be prepared using expansive soil [black cotton soil].

0435 STABILIZED SOIL BLOCK

Stabilized soil block shall be prepared of clay with a possible minimum amount of drying shrinkage. It shall not be prepared using expansive soil [black cotton soil].

Stabilized soil block for exposed to moisture or rainfall masonry wall shall be made water resistant.

0436 BUILDING MORTAR

04361 Component Materials

- Cement for building mortar shall be Portland cement complying with the requirements of ESC D5 201.
- Lime for building mortar shall be hydrated lime complying with the requirements of ESC D5 003.or quick lime complying to BS 890 giving a compressive strength of 20kg/cm2 for a lime/sand mix 1:3 proportion after slacking for 2 hours.

Quick lime shall be slaked on site for as long as necessary but not less than 14 days.

Quick lime shall be slaked in boxes or lined pits, ensuring that no contact is made with earth or other objectionable material. Sufficient water shall be added to make the liquid volatile. All impurities and solid material shall be filtered out of the lime before it is used for the works.

Lime from different sources or different stacking time shall not be used in any one mix.

Lime shall be used in the order delivered.

- Aggregate for building mortar shall be natural occurring river or pit sand or crushed aggregate complying with the requirements of BS 1200.

04362 Building Mortar for masonry work

Cement mortar for stone walling shall be 1 part cement and 3 parts aggregate. Cement mortar for brick and block walling shall be 1 part cement and 4 parts aggregate. Compo-mortar for walling shall be 1 part cement, 2 parts slaked lime and 9 parts aggregate.

04363 Mixing mortar

The ingredients of mortar shall be measured in accurate gauge boxes for volume. Mortar shall be mixed in an approved mechanical batch mixer. Dry ingredients of mortar shall in the first instance, be mixed until there is a uniform consistency in colour. Water shall be added and the mixing continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. In no case shall mixing be carried out for less than two minutes after adding water. Sufficient water shall be added to the mix to produce a pure consistency.

In instances where hand mixing is unavoidable, the cement content shall be increased by 10%. The dry and wet mixes shall be turned over sufficient number of times to produce the respective consistencies as required by batch mixers.

Mortar shall not be allowed to stand more than 1 hour without mixing.

Cement mortar shall be used within half hour of adding cement to the mix. Compo-mortar shall be used within one hour of adding cement to the mix.

044 EXECUTION

0441 SAMPLES

Sample panels of each type of facing wall not less than one square meter in area including joint pointing, if finish is in pointing shall be prepared for approval by the Engineer. All construction thereafter shall in all respects comply with the approved sample.

Samples shall be maintained and kept in their original condition until permission to remove them is granted by the Engineer.

0442 CONSTRUCTION

Concrete and other surfaces to receive walls shall be clean from earth, dust, debris, etc and wetted before mortar is laid on the surface.

Where no concrete or other bedding material is provided under masonry works, a minimum thickness of 50mm aggregate shall be placed on the excavated bottom and the surface wetted before the application of mortar.

Walls shall be set out with rods for courses, opening heights, etc., and shall be built to the width, depth and heights as shown on drawings or directed by the Engineer.

Walls separated by concrete or other material shall be built plumb and with deviations of not more than 3 mm in 3 meters. Walls shall be carried with no portion higher than 1000mm above adjacent wall at any one time.
Wall shall be bonded as detailed on drawings or directed by the Engineer.
Walls below grade shall be built in cement mortar only, and walls above

grade in cement or Compo-mortar as specified in drawings or bill of quantities.

The best of workmanship shall be used in the construction of facing walls.

0443 CURING & PROTECTION

Walls shall be protected from premature drying and excessively high temperatures for at least 28 days from the date of building. The surface of walls shall be kept wet by the application of water for at least 7 days. Walls and their surfaces shall be protected from damage by other trade.

0444 CLASSIFICATION

04441 Stone Masonry Walls

044411 General

Stone masonry walls shall be built in stone and mortar as specified in the product section of this Specification They shall be built to the dimensions and inclinations shown on drawings.

Stone walls shall be built to bead together through out the wall. The mortar for stone wall bedding shall not be less than 20mm in thickness and shall be distributed to fill the cavities formed by joining stone.

044412 Stone wall concealed from view or to be left for further finish.

Stone wall concealed from view or to be left for further finish shall be built in stone sizes of not less than 300mm high per course and 400mm wide per stone. Faces of stone walls to receive further finish shall have horizontal and vertical joints raked out to form adequate key for further finish.

044413 Rough dressed stone wall facing

Unless given in detail drawings, rough dressed stone walls shall be built in stone sizes of not less than 300mm high per-course and 400mm wide per stone. The joints of the fair chiseled natural stones shall be finished slightly proud and cleaned off flush at completion.

The joints shall be raked out to a depth of approximately 15mm as the work proceeds and prepared for pointing.

044414 Dressed stone wall facing

The pattern, type and size of the stone units and the pattern of laying and bonding for dressed stone walls shall be as detailed on drawings.

The joints of dressed stone walls shall be finished slightly proud and cleaned off flush at completion.

The joints shall be raked out to an approximate depth of 15mm as the work proceeds and prepared for pointing.

04442 Concrete Block Works

044421 General

The mortar for block walling shall have a maximum thickness of 15mm and shall be evenly distributed between vertical and horizontal joints of blocks.

044422 Sub-grade block works

Sub-grade block works shall be built in class AA hollow block walls or class AA solid block walls and cement mortar only.

044423 Above grade walls.

Walls above grade shall be built in blocks of the class and cement or compo-mortar as indicated on drawings or in the bill of quantities. Walls shall be built with selected blocks. The horizontal and vertical joints of blocks shall be raked out to form adequate key for block work on which further finish is to be applied.

The joints for fair faced block work shall be raked out to a minimum depth of 10mm and prepared for cement pointing.

04443 Brick Walls

044431 General

The mortar for block walling shall have a maximum thickness of 15mm and shall be evenly distributed between vertical and horizontal joints of blocks.

044432 Sub-grade brick walls

Sub-grade brick walls shall be built in least porosity and high strength solid bricks only. Only cement mortar shall be used for sub-grade brick work.

044433 Above grade brick work

Above grade walls shall be built in bricks selected for their edge and straightness.

Above grade walls shall be built in cement or comp-mortar as indicated on drawings or specified in the bill of quantities.

Above grade face walls shall be built in bricks selected for their strength, straightness, uniformity in colour and texture.

The horizontal and vertical joints of brick walls shall be raked out to form adequate key to receive further finish.

The horizontal and vertical joints of brick facing walls shall be raked out to a minimum depth of 10mm and prepared for cement pointing.

04444 ADOBE WALL

Adobe shall be made up of a mixture of clay, water and chid will have high resistance to drying shrinkage cracklings.

Adobe shall be prepared with a minimum possible amount of water and dried gradually before use.

04445 STABILIZED SOIL BLOCK WALL

Stabilized soil block could be made of a mixture of soil, water and Portland cement, or soil, water and portland-pozzolana cement, or soil, water and lime or other combinations.

Stabilized soil block wall for exposure to moisture or rain shall be made water resistant.

045 MASONRY WORK ANCILLARIES

0451 REINFORCEMENT TO MASONRY WORKS

The provision of reinforcement is the Concrete Section" of this Specification in equally applicable to reinforcement laid in layers to reinforce masonry works or tie masonry work to other parts of structure.

The reinforcement shall be laid at layer intervals as shown on drawings.

The mortar cover to reinforcement shall not be less than 20mm.

0452 ANCHORS & GROUNDS

Anchors and hoop iron placed in masonry to tie doors & windows or other elements to stone walls shall be in mild steel plates of not less than 0.8mm in thickness and 10mm wide formed to the shapes shown in drawings. Anchors shall be coated in one coat of anti-rust paint. Anchors shall be securely fastened to masonry units in mortar of the same composition as used for the masonry works or screwed to the walls.

Grounds shall be in timber blocks seasoned for joinery and not less than 40mm square in size. Grounds shall be securely anchored to wall in mortar of the same composition as the walls or screwed to the walls.

046 METHODS OF MEASUREMENT

0461 Masonry work shall be understood to include, shaping, cutting, placing, bonding, tying, wedge placement, building to ends of other material and preparation of surface for further finish.

0462 Reinforcement to masonry wall & concrete in-fill shall be measured separate in accordance with the methods of measurement in concrete work.

0463 Masonry work shall be differentiated for material and: -

- Above and below grade work
- Straight and tapering surfaces
- Face finish
- Mortar type

0464 The unit of measurements are: -

- Stone wall by volume
- Stone paving by area specifying thickness
- Brick & block wall by area specifying thickness

0465 Deductions

No deducts shall be made in masonry work for opening up to 0.25m2 in area.

051. ROOF WATER PROOFING & DAMP PROOFING

051 GENERAL REQUIREMENTS

0511 Work Included

Provide all liquid membrane patching roof materials labour and tools and perform all water proofing as shown on drawings, specified herein and required for a complete and satisfactory installation of the works.

0512 Related works

Cast in place concrete	Section 031
Roofing & cladding	" 06

0513 Quality Assurance

05131 Standards:- Comply with the following standards.

Built up roof concrete primer	ASTM D-41.78
Built up roof heavy duty coating	ASTM D-2823.75
Built up roof patching compound	ASTM D-2822.75
Built up roof membrane	ASTM D-224.81
Built up roof aluminum roof coating	ASTM D-2824.76
Damp proof courses	BS 743

05132 Qualification of workmen

Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are thoroughly familiar with the specified requirements and methods needed for proper performance of the work in this section.

05133 Submittals

Submit manufacturers' catalogue for approval prior to proceeding with placing of order. The catalogue shall show properties of materials and methods of application and guarantee duration. Sample material in addition to manufacturers catalogues shall be submitted if required for approval by the Engineer.

05134 Compliance

All submittals shall comply with the general submittal and substitution sections of the General requirements of this Specification.

05135 Product data

Submit complete product data for approval within the time to be prescribed after signature of contract based on the schedule of work indicating the following and other information as may be requested by the Engineer.

- List of proposed items to be furnished and installed under this section.
- Manufacturers' name(s), brand and place of manufacture.
- Manufacturers' specifications showing, the property of materials, application methods and tools for application.
- Sample of materials if requested by the Engineer.

0514 DELIVERY & STORAGE

Deliver all materials to the site in their original unopened containers with all labels intact and legible up to the time of use. Store in strict conformity with the manufacturers' recommendation or with the requirements of delivery and storage of the General Requirements section of this Specification.

0515 PROTECTION

Adhere to manufacturers recommendation if given or take all precautions necessary to protect the materials during transport, delivery, storage, and handling and before and after installation. Protect the works from being damaged or causing damage to other trades.

0516 REPLACEMENT

In the event of damage before or after installation, take immediate action to repair, rectify or replace as necessary and to approval by the Engineer at no additional cost to the owner.

0517 GUARANTEE

Ensure that the guarantee covers a minimum of 10 years or the time and performance requirements of the owner if over 10 years.

0518 PRODUCTS

05181 Concrete Primer

Concrete primer shall be liquid, produced from high quality asphalt, capable of absorbing dust and scale to provide bondable concrete surfaces. It shall be applied as an undercoat for built-up roofing.

05182 Heavy Duty Roof Coating

Heavy duty roof coating to be applied at successive coating for built up roofing shall comply with the requirements of ASTM D 2823.75 and shall be an asphalt base material.

05183 Heavy Duty Patching Compound

This product shall be asphalt based complying with ASTM D 2822.75, capable of sealing and fitting patches to produce smooth & water proof surface.

05184 Roof Membrane

Roof membrane shall be heavy duty reinforced mat composed of polyester strands bonded under heat and pressure complying with the requirement of ASTM D 224.81.

05185 Bitumen Damp Proof Courses

Damp proof course liquid and sheeting shall comply with the requirements of BS 743. The sand for bitumen damp proof course shall comply with the requirements of BS 1289 Table.2

0519 EXECUTION

05191 Surface Preparation

Surfaces to receive water proofing and damp proofing shall be clean of dust, dirt and loose debris. Ensure those surfaces are fully dry before the application of roofing & water proofing.

Roof water proofing shall be applied only after work in other trades that may interfere with water proofing have been executed.

No other work on roof that may require the cutting or patching of built up roof shall be executed after water proofing work is stated.

05192 Application

Application of water proofing and damp proofing shall be executed in strict conformity with the selected manufacturers instruction or as detailed in schedules annexed to this specification.

All coating shall be in strict conformity with the requirement, as with particular care being taken to note the following: -

- Sequence of laying,
- Volume or weight of material required for unit area
- Number of layers of each material
- Laps Returns, Angles, Intersections & Directions
- Patching & sealing requirements
- Interval between requirements
- Tools for cleaning and laying
- Movement of workmen
- Aggregate and bitumen proportion for damp proofing.

05120 METHODS OF MEASUREMENT

The following are understood as included in the measurement.

- Perforating and sealing around pipes, stands and the like.
- Nailing, bolting, screwing
- Cutting, waste, trimming, jointing and the like.
- Overlaps & returns.

Roofing & water proofing shall measured by area, without addition for laps and seams.

- Decorative (reflective) coat to roofing shall be measured separate.

06. ROOFS AND WALL CLADDING

061 DEFINITION

062 GENERAL REQUIREMENTS

0621 RELATED WORKS DESCRIBED ELSEWHERE

Concrete	Section 03
Water Proofing & Damp Proofing	Section 05
Carpentry & Joinery	Section 07
Steel Structure	Section 09
Metal Work	Section 10

0622 QUALITY ASSURANCE

06221 Standards

Comply with the following standards

ES C.D7.001	Galvanized plain sheets, ESI
ES C.D7.026	Galvanized corrugated sheets, ESI
ES C.D3.501	Asbestos cement sheets, ESI
ES G.B4.120	Steel wire nails, ESI
BS 2855	Corrugated aluminum sheet for general purposes
BS 1470	Wrought aluminum and aluminum alloys sheet and trip
BS 2465	Aluminum fixing accessories
BS 1490	Fixing accessories for building purposes
BS 402.1779	Clay plain roofing tiles and fittings

06222 Qualification of Workmen

Generally comply with the requirements of qualification of workmen in the workmanship section of the General Requirements of this Specification. In addition to these requirements, assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the works of this section.

06223 Submittals

Submit manufacturers test certificates, as directed by the Engineer for standards of coatings of material and other properties.

06224 Compliance

Comply with the general submittal, substitution and sampling sections of the General Requirements of this Specification.

06225 Product Data

Submit product data for approval immediately after signature of contract indicating the following: -

- Source of material for roofing and cladding and the sealants and fixing devices proposed.
- Manufacturers certificate showing properties of materials.

0623 DELIVERY & STORAGE

Roof and cladding sheets and accessories shall be protected against damage in transit to the site. Manufacturer proposed methods of packing and stacking in transit shall be strictly adhered to.

Roof and cladding materials shall be stacked on wood blocking clear of the ground and tilted slightly.

Sheets and accessories shall at all times be stored under shed.

063 PRODUCTS

0631 General

Roof and wall cladding and accessories shall be as indicated in the drawings and specified herein supplied from manufacturers approved by the Engineer. Roof fixing accessories shall always be obtained from suppliers recommended by the Manufacturer.

0632 Galvanized Steel Sheets and Accessories

06321 Galvanized corrugated steel sheets

Galvanized corrugated steel sheets for roof and wall cladding shall comply with the requirements of ES C. D7.026 for size, thickness and galvanization requirement.

Galvanized corrugated sheets less than 32 gauge shall not be used for the roofing or wall cladding of permanent structures.

06322 Galvanized plain steel sheets

Galvanized plain steel sheets for cladding shall comply with the requirements of ES C.D7 001 for size, thickness and galvanization requirements. Galvanized steel plain sheets less than 28 gauge shall not be used for of cladding permanent structures.

06323 Galvanized plain steel sheet accessories

Galvanized steel plain sheet accessories like ridge caps, gutter, down pipes, flashing, copping, edge trims, corner moulds, and return, etc shall comply with the requirements of Specification 062423 for material standards.

Galvanized plain steel sheet accessories shall be formed and fabricated in accordance with the details in the drawings or shop drawings approved by the Engineer.

The sheets shall always be cut to the maximum possible length to keep the number of joints to the minimum possible. Where the over lapping of sheets is unavoidable, the edges shall be over lapped a minimum distance of 150mm and welded/soldered.

06324 Fixing Accessories for Galvanized Steel Cladding

063241 Nails

Galvanized steel sheet cladding and accessories shall be fixed to timber using chisel or diamond edge and convex head galvanized nail drawn from mild steel round wires.

They shall comply with the requirements of ES G.B4.120. Washers shall be diamond or flat pattern produced from rubber of bitumen coated fiber homogeneous and free from porosity and grit.

063242 Hooks, Bolts, Nuts & Screws

Galvanized steel sheet cladding shall be fixed to steel structure in steel hooks or bolts and nuts. Steel hooks, bolts, nuts and screws shall be zinc coated mild steel complying with the requirement of BS 1494.

The sizes of fixing accessories shall be as recommended by the manufacturer or detailed on drawings. The size shall always match the structure on which the cladding is to be fixed. Fixing accessories shall generally comply with the requirement of BS 1494.

Washers shall be diamond or flat pattern produced from rubber or bitumen coated fiber homogeneous and free from porosity and grit.

063243 Hangers and brackets

Hangers, brackets and anchors shall be of formed mild steel not less than 2mm thick and 10mm wide.

Hangers, brackets and anchors shall be fabricated in accordance with the detailed drawings. Hangers, brackets & anchors shall always be primed with anti-rust paint. Where the cladding accessories are finished painted they shall also be finished painted in the same paint and colour.

0633 Asbestos Product

06331 Corrugated asbestos roofing & cladding

Corrugated asbestos cement sheets shall comply with the requirements of ES.C.D3.501. Asbestos cement sheets shall be of prime grade, free from visible defects, which might impair the appearance or serviceability of the sheet. The surface of sheets shall be uniform in texture, smooth on one side, and the edges square, straight and clean.

Asbestos cement sheet for roofing shall be 6mm thick.

06332 Flat asbestos cladding

Flat cement asbestos cladding shall be free from visible defect that might impair the appearance and serviceability of the sheet. The surface shall be uniform in texture and the edges square, straight and clean. Flat asbestos shall comply with ES C. D3.501 for material quality.

Flat cement asbestos cladding shall be for external use only. The asbestos shall be prime grade, and in thickness of 4 or 6mm as indicated on drawings.

06333 Ridge caps, flashing and aprons

Ridge caps shall be single piece or two piece adjustable close fittings.

Flashing and aprons shall be single piece. Were flashing and aprons are applied against corrugated asbestos cement sheets, the side wing resting on the corrugated sheets shall be corrugated to match the sheets. Both wings of caps, flashing & aprons shall be plain if not fixed against corrugations.

06334 Fixing accessories

Comply with the requirements of Specification 062432 for fixing asbestos cement sheet and accessories to timber steel structure.

0634 Galvanized Ribbed Sheets

06341 Galvanized ribbed steel sheet roofing & cladding

Galvanized steel ribbed sheets shall comply with the requirements of ES.C.D7.026 for galvanization.

Galvanized steel ribbed sheets shall comply with the requirements of the manual of "Kaliti Steel Industry, 1985 - galvanized cold formed steel for roof, window and door profile and fittings" or such other standard acceptable to the Engineer. The sizes, thickness, distance between ribs etc. shall be in accordance with the guide lines in the Manual.

06342 Ridge caps, flashing and accessories

Comply with the requirement of Specification 062423.

06343 Fixing accessories

Comply with the requirements of Specification 062432 for fixing ribbed sheets and accessories to timber and steel structure.

0635 Aluminum Sheets and Accessories

06351 Corrugated aluminum sheet roofing & cladding

Corrugated aluminum sheets shall comply with the requirements of BS 2855.

The minimum thickness of corrugated sheets shall be 24 SWG.

Corrugated sheets shall have uniform corrugation parallel with the sides of the sheets.

Sheets shall be clean and free from defects that would affect their use. Sheets shall be finished as rolled or with special surface finish as indicated in drawings.

06352 Aluminum plain sheets accessories

Aluminum plain sheet accessories like ridge caps, gutters down pipes, flashing, copping, edge trims, etc., shall be manufactured from aluminum complying with BS 1470.

Aluminum plain sheet accessories shall be formed and fabricated in accordance with the details in the drawings. In the instance of the accessories being factory manufactured, the method of fabricating shaping, etc., shall comply with the relevant British or other standards approved by the Engineer.

06353 Fixing accessories

Hooks, bolts, nuts & screws shall be manufactured from aluminum alloys. The products shall comply with the requirements of BS 2465 for material, workmanship threads and hooks.

Washer shall be diamond or flat pattern produced from rubber or bitumen coated fiber homogeneous and free from porosity and grit.

0636 Clay Roof Tiles and Fittings

Clay roof tiles and fittings shall comply with the requirements of BS 402.

Tiles shall be manufactured from wet weathered and prepared clay.

These shall be uniformly burnt through out, free from fire cracks, true in shape, dense and tough. Clay tiles shall show clean fracture when broken.

Clay tiles shall not be less than 10mm in thickness. The sizes of tiles shall be as indicated in drawings.

Tile fittings shall be manufactured from the same clay as the material for the tile.

Clay tiles shall be fixed to timber using roof nails as described under corrugated steel sheet fixing accessories. The holes in clay tiles and fittings shall be pre pierced.

0637 Natural Fiber Reinforced Mortar Roofing Tile

In the absence of standardized specifications and test procedures, approaches shall comply stipulated standards for asbestos-cement roofing sheets or ordinary concrete tiles. [UNCHS, HABITAT Technical Notes, N..,O, April 1987.]

The manufacturer shall satisfy and provide a certificate to indicate that the products comply with the tests and other requirements.

Fiber reinforced tiles shall be water tight and strong.

Fiber reinforced tiles shall be made of a mixture of sand, Portland cement and water with or without sisal fiber.

Tiles could be produced of a mixture of sand, Portland cement,pozzolanic material powder and water.

Tiles shall be cured properly and gradually dried before use.

0638 UPVC Down pipes, gutters and strainers

Comply with the requirement of UPVC products in the Sanitary Installation section this Specification.

064 EXECUTION

0641 GENERAL

Fixing of cladding shall be fully water tight and performed to the best standard of the trade.

Roofing & other cladding shall be constructed with sufficient slope or camber to ensure adequate drainage including the avoidance of possible ponding of water Due to deflection.

Roofing and other cladding shall be fixed to fully resist up-lifting and overturning.

Fixing hole on cladding shall be drilled in crown. Holes shall be 5mm larger in diameter then bolts and hooks and located not less than 40mm from the edges of sheets.

The erection and fixing of cladding and accessories shall generally be in accordance with the material manufacturers recommendation and the detailed drawings.

No person other than workmen fixing cladding shall have access to the area while roofing is under construction.

Access to fiber reinforced tile roofs such as roof-boards shall be provided and at no times shall a person be allowed on the roof without the use of such walkways, roof-boards, cut-ladder or crawling boards.

Notices warning workmen not to step on to the fiber reinforced roof tile shall be provided in conspicuous positions on the walkway and at all usual points of access to the roof.

Sufficient over hang or other means shall be produced as weather protection for walls susceptible to dampness penetration.

Cladding shall be laid with upper laps away from prevailing wind.

0642 LAYING

Galvanized steel corrugated & ribbed sheets and aluminum corrugated sheets for roofing shall be laid with end laps not less than 150mm and side laps not less than one and half corrugations.

Vertical cladding sheets shall be laid with end laps not less than 100mm and side laps not less than one corrugation.

Corrugated asbestos sheets shall be laid with end laps not less than 200mm and side laps of one corrugation minimum.

Ridges, flashing, etc to asbestos roofing shall be filled with mastic or sand and bitumen mix to ensure that the joints are water tight.

Roofing & cladding and accessories shall be securely fastened to the structure as recommended by the manufacturer or, as details on drawings in the materials specified in section 06243 of this Specification.

0643 GUTTER & DOWN PIPES

Gutter shall be laid to slopes as indicated in drawings. If not indicated the slope shall not be less than

0.05% Gutter and down pipes shall be over lapped minimum 150mm and joints welded or soldered. The lower level piece of down pipes and gutter shall be on the outer face at joints.

The area around the joints and returns of gutters shall be treated with three coats of zinc paint.

Support brackets shall be placed as indicated in drawings or at a maximum distance of 1000mm apart and at all changes of angles, direction and at ends.

UPVC down pipes and gutters shall be fixed as in above but in compliance with the Sanitary Installation section of this Specification.

065 METHODS OF MEASUREMENTS

0651 General

Work measured by area shall be measured flat over the projected area without addition for slopes, laps and beams.

Work measured by length shall be measured net without addition for laps, passings, angles, end and the like.

The following shall be understood as included

- Perforating and sealing roof around pipes, stands and the like.
- Nailing, bolting, screwing and the like to fix roofing and accessories.
- Battens, joists, runners, wedges and splicers in wood.
- Covering lists, back supports, brackets, and other supports to roof and accessories.
- Cutting, waste, bracing, trimming, boring, sinking, jointing and the like.
- Returns to gutters, down pipes flashing and aprons.

0652 Measurement

Roof cover, side cladding, water proofing and the like shall be measured by area.

Ridges, flashing, aprons down pipes, gutters and the like be measured by length stating girth.

Roof lights, ventilators, special roofing sheets shall be measured by area, length, or enumerate extra over roofing without deduction for roofing.

Gutter and down pipes shall be measured by length taken along the center line and shall be deemed to include supports, brackets and fittings. The development sizes shall be given.

Insulation shall be measured by area where not described as a composite item.

Rainwater spout shall be enumerated stating the size and length.

07. CARPENTRY & JOINERY

071 DEFINITIONS

Carpentry: Work on timber and posts mainly intended for structural purposes and not requiring the milling of timber to finish surface smooth.

Joinery: Work on timber for finishing purposes where the timber is finished milled and accurately joined.

Sawn timber: Timber cut to required size and shape in a saw mill or work site but not planed to smooth surface.

Milled Timber: Timber cut to required size, shape, notching, rebating and other works as may be required for the intended jointing detail. All faces of the timber shall be finished smooth before they leave the place of manufacture.

072 GENERAL REQUIREMENTS

0721 WORK INCLUDED

Provide all carpentry and joinery timber, laminated panels, fixing devices paints, posts, glue and other material necessary for a complete and satisfactory fabrication and installation of carpentry and joinery work.

0722 RELATED WORKS DESCRIBED ELSEWHERE

Masonry works	Section 04
Hardware (Iron mongery)	Section 08
Metal work	Section 10
Painting	Section 12
Glazing	Section 13

073 QUALITY ASSURANCE

0731 STANDARDS

Comply with the following standards.

ES.C.D1.101	Chip boards, ESI.
ES.C.D1.103	Plywood, ESI.
BS 3444	Block Board & Laminboard
ES.G.B4.120	Nails, ESI
BS 1210	Wood screws
BS 1204	Synthetic resin adhesives
ES.C.D3.501	Asbestos cement sheets

0732 QUALIFICATION OF WORKMEN

Throughout the progress of the work, provide at least one person, each for Carpentry and Joinery who are thoroughly familiar with the specified requirements, fully trained and experienced in the necessary skills and who shall always be present at the place of work and direct all workmen in the selection of materials, preparation, fabrication, installation and cleaning.

0733 SUBMITTALS

Submit product data for approval by the Engineer well before fabrication of carpentry and joinery indicating the following.

- Proposed type of timber posts and laminated panels to be used for carpentry and joinery.
- Proposed methods of impregnating timber & posts.
- Proposed place of fabrication of joinery.
- Shop drawings of joinery work showing general arrangement, details of construction and materials, jointing, finishing and other related details.

0734 PROTECTION

Protect carpentry & joinery material from breakage, warping surfaces scratch and other damage during transport and storage.

Protect installed carpentry & joinery work from damage by work on other trade.

0735 DELIVERY & STORAGE

The proposed methods of the storage and handling of carpentry & joinery posts and timber requires the specific approval of the Engineer.

Timber & posts shall be purchased at the contractors expense immediately after taking over site and are to be open stacked off the ground for as long as possible before use.

Timber and posts shall be protected from exposure to excessive humidity and sunshine.

Timber and posts shall be stored in a manner that would protect them from attack by termite, insect and decay.

In addition to the above requirement, seasoned timber shall be stacked in roofed and walled enclosures to minimize variation in moisture content beyond the acceptable limits.

Panel boards & assembled joinery shall be neatly stacked in an enclosed space in a manner ensuring no damage to the panels and assembled work caused by stacking weight and variations in temperature & humidity.

Fixed joinery liable to be bruised or damaged in any way, shall be completely protected until the completion of the construction. Exposed and finished items shall be removed and or loosened and protected while decoration work is being carried out and re-fixed afterwards.

0736 Samples

Samples of each type of work in its component material, fabricated, assembled fixed and finished forms shall be produced as required for approval by the Engineer.

All materials and work thereafter shall in all respects, comply with the approved samples. Samples shall be maintained and kept in their original condition until permission to remove them is granted by the Engineer.

074 PRODUCTS

0741 GENERAL

The types of products indicated hereunder are the minimum recommended types of materials to obtain the required standard of work. The Engineer may use substitute materials of equivalent or higher standards subject to approval. Timber, posts and boards to be used for carpentry and joinery shall be of the highest quality of the selected type and obtained from sources approved by the Engineer.

Timber and posts susceptible to attack by timber destroying fungi, insects, borers and decay shall be treated with suitable preservatives prior to use. Timber & posts coming in contact with earth, weather or not requiring treatment, shall be treated with wood preservatives.

The preservatives and methods of application shall be approved by the Engineer before such application is started.

The surfaces of treated timber, that have been cut or machined shall before assembly, be coated with three coats of wood preservative approved by the Engineer.

Timber and posts requiring treatment shall be pealed, sawn and seasoned to the required standards prior to the application of treatment.

Timber shall be treated by pressure impregnating, dipping, brush application or spraying depending upon the requirement of the treatment of the timber selected.

Timber and posts required to be treated, but not requiring pressure impregnating shall be treated with three coats of brush applied or sprayed in external treatment with preservatives approved by the Engineer. Timber and posts may alternately be dipped in the preservative for sufficient time that would produce equal effect as the three coats of brush or spray application of the preservative.

Pressure impregnated timber and posts shall be treated with preservatives and treatment methods approved by the Engineer at a pressure of not less than 10 Atmospheres and in accordance with the chemical manufacturers instructions.

Timber and posts shall be seasoned to a moisture content of not more than 20% for carpentry. Timber for joinery shall be seasoned to a moisture content of not more than 12%. Treated and untreated timber ready for use shall be free from live borer, beetle or other insect attack.

Measures necessary to prevent further insect attack of timber and posts shall be taken, once the timber is delivered.

Timber and posts, whether already approved for use or used, shall be removed and replaced at the contractor’s costs, if indications of their being attacked is evident.

0742 PRODUCTS FOR CARPENTRY WORK

07421 Posts

Posts for carpentry shall be eucalyptus, Kerero, Tid or other equivalent and approved wood product. Posts shall be uniform in diameter. Posts that have developed cracks shall not be used. Posts shall be pealed off and allowed to season until the acceptable moisture content is achieved.

Eucalyptus and Kerero posts to be exposed to weather or buried below ground shall be pressure impregnated.

Tid posts to be buried below ground shall receive three coats of approved external preservative. Eucalyptus and Kerero posts for use in weather protected areas or covered by other material shall receive three coats of approved wood preservative.

07422 Timber

Carpentry timber shall be sawn Zigba, Tid, Kerero, Wanza, etc., or other approved wood product. Zigba, Kerero and other approved timber to be buried below ground or exposed to weather shall be pressure impregnated.

Tid timber to be buried below ground shall receive three coats of approved external preservative. Zigba, Kerero and other approved timber to be used in weather-protected areas or covered by other material shall receive three coats of approved wood preservative.

Carpentry timber shall be new and to be used for the intended purpose only. Carpentry timber shall be sawn on all faces to the specified dimensions and within allowable deviations.

0743 PRODUCTS FOR JOINERY WORK

07431 Joinery timber shall be pressure impregnated Kerero, Tid, Woira or other approved timber, seasoned to the allowable limit.

Joinery timber shall be milled to the accurate dimensions required for the work.

Joinery timber other than those requiring preservative treatment shall be pressure impregnated.

Joinery timber shall be straight grained. Grains appearing on the surface of finished joinery work to be stained shall be of the same character.

Exposed surfaces of timber for joinery shall not have visible knots impairing the appearance of the finished surface.

Timber for joinery work not exposed to view may have knots on one face provided such knots do not affect the structural strength of the timber.

Timber that has developed visible cracks shall not be used for joinery work.

07432 Panel Boards

074321 Plywood

Plywood shall be prime quality Kerero, mahogany or other approved material in the thickness specified in drawings and complying with the requirements of ES.C.D1.103.

Joinery plywood shall be selected for the face veneers being fit for smooth finish. Plywood veneers shall be free of joints, overlaps, open defects, depression, etc., on exposed faces. In the instance of joints on faces being unavoidable the plywood shall be selected for uniformity of grain character.

074322 Chipboard (Particle Board)

Chipboard shall be prime quality in the specified thickness complying with requirements of ES C.D.101. Chipboard shall be straight edge and free of visible defects that might impair strength and appearance. The exposed face of chipboard shall be smooth enough to receive further finish application.

074323 Block boards

Block board may be produced from plywood, chipboard or milled timber joined and glued together to form the core. The faces of the core shall be covered with veneer of thickness not less than 3mm glued to the core slab.

The exposed faces of block boards shall have selected surfaces for smooth finish. Block boards shall be free of any surface defects that might impair the appearance of the surfaces.

The edges of block boards shall be lipped in milled timber with the finished timber face width not less than 10mm.

074324 Hard & soft boards for ceiling work shall be in the specified thickness, selected for straight edges and consistency in surface grain.

The surfaces of hard & soft boards shall be smooth or uniformly textured to receive paint finish.

074325 Veneer lamination to core slab other than ordinary plywood used to achieve high standard finish shall be in the specified material glued to the core slab. Veneer for such lamination shall not exceed 2mm thickness and shall have uniform grain.

074326 Formica lining to core slab for the surfaces of counters exposed to moisture shall be of approved colour and not more than 4mm thickness.

074327 Asbestos cement sheet shall comply with the requirement of Specification 062432.

07433 Screws & Nails

074331 Screws to be used for joinery shall be round head, slotted or counter sunk produced from steel, brass or aluminum. Screws shall be selected for sizes matching depth of panel to be fixed.

074332 Nail for carpentry & joinery work shall comply with the requirement of ES.G.B4.120. Nails shall be free from oxidation. The surfaces of nails shall be finished galvanized, lead coated or resin coated.

074333 Synthetic resin adhesive for joinery assembly work shall comply with the requirement of BS1204.

Adhesives shall be stored and used in strict conformity with the manufacturer instructions. The type of adhesives shall be selected for the weather condition to which the joinery is exposed. Adhesive shall be used only within the time limit allowed by the manufacturer. Adhesives and work produced by over dated adhesives shall be rejected.

075 FABRICATION & FIXING

0751 GENERAL

Actual dimensions of scantlings for both carpentry and joinery shall not vary from the specified dimension and shall be uniform in thickness through out. Boards shall hold up to the specified thickness and timber shall be as long as possible and practicable in order to eliminate joints.

Carpentry work shall be left with sawn surface except where other finishes are specified. Carpentry work shall be done in milled timber, if the finishes to be applied require so.

Profile of sections for carpentry & joinery shall not be modified from those shown in drawings or specified in schedules without the prior approval of the Engineer.

Joinery shall be accurately set out on boards to full size for the information and guidance of the artisans before commencing the respective work.

Joinery shall be cut and framed together soon after the commencement of the building or as is practicable, but is not to be wedged up or glued until the building is ready for fixing. Any portions that warp, wind or develop shakes or other defects within the Maintenance Period, after completion of the construction shall be removed and new ones fixed in their places together with all other related works, which may be affected thereby.

Joinery shall be properly mortised, tenoned, housed, shouldered, dovetailed notched, wedged, pinned, etc. as directed by the Engineer and all properly glued up with approved glue.

Joints in joinery must be specified or detailed, and so designed and secured to resist or compensate for any stress to which they may be subjected. Nails are to be punched and stopped.

Joints are to be made not tight where shrinkage is liable to occur and glued where sealed joints are required.

Glue for load bearing joints and where conditions are damp must be resin type.

Exposed surface of joinery work shall be wrought and all arises " eased off" by planning and sand papering to an approved finish.

Beads, fillets and small members shall be fixed with round or oval brads or nails well punched in and stopped. Large members shall be fixed with brass screws, the beads let in and palleted to match the grain.

Ground for external and internal work shall be in approved timber. Holes for plugging in grounds must be completely filled with the grounds.

Grounds for fixing joinery shall generally be placed at 500mm center-to-center intervals.

Hardware (Iron mongery) types and locations for each joinery items shall be verified prior to cutting, rebating or any work associated therewith.

Hardware for joinery is dealt with in Section 8 of this Specification.

Paints for carpentry & joinery is dealt with in Section 8 of this Specification.

0752 CARPENTRY CLASSIFICATION

07521 Post Truss and Rafter

Trusses and rafters shall be fabricated from eucalyptus or other equivalent posts complying with Specification 07421. Trusses and rafter shall be fabricated as detailed in drawings.

Members shall be spliced where necessary, securely nailed to each other and tied with mild steel bands at all joints.

Trusses and rafters shall be securely tied to supports detailed on drawings. Where no details are shown, 6 or 8mm diameter mild round steel tie bars embedded in, welded to or tied around support shall be used to tie truss and rafter secure in position.

07522 Purlins

Purlins shall be produced from eucalyptus or other equivalent posts complying with Specification 07421.

Purlins shall be in the sizes shown in drawings. The splices of purlins at joints shall be minimum 600mm where no details are shown in drawings.

Members shall be securely nailed to trusses and rafters.

07523 Timber truss and rafter

Truss and rafter shall be produced from timber complying with the requirements of Specification 07422. Timber trusses and rafter shall be produced in accordance with the detail drawings.

Splicing and over lapping shall be at locations shown in the drawings. Change of location of overlap requires the approval of the Engineer.

Truss members shall be securely nailed to each other. Additional ties in steel strands shall be provided at joints if indicated on drawings or

directed by the Engineer. Wedges, seats, etc., shall be provided as detailed on drawings.

Trusses & rafter shall be securely tied to support as shown in drawings. Where no details are shown, 6 or 8mm diameter, mild round steel tie bars embedded in, welded to or tied around support shall be used to tie truss and rafter secure in position.

07524 Timber purl in

Purlins shall be produced from timber complying with Specification 07422 in accordance with the sizes and details shown in drawings.

Straight piece purlins shall be used to full uncut length of the timber as it arrives. Joint overlaps or splices shall not be less than 600mm. Purlins shall be securely nailed or bolted to trusses and rafters.

07525 Post and timber uprights, beams & bracings

Uprights beams and bracings in posts and timber shall comply with the requirements of Specification 07421 & 07422. Uprights, beams & bracing shall be selected for uniform dimension and straightness.

Uprights, beams and bracings shall be fixed in accordance with the details shown in drawings. Members shall be securely embedded, tied or anchored as shown in detailed drawings.

0753 JOINERY CLASSIFICATION

07531 Ceiling

075311 General

Ceilings shall generally be built in the type and size of materials shown in drawings. The thickness as shown in drawings shall be maintained.

Ceiling shall be laid in accordance with the patterns and panel sizes shown in drawings. In the instance of no patterns and sizes being given, the work shall be executed in accordance with the directions of the Engineer. Unless directed, the face of the panels to be exposed to view shall be smooth enough to receive further finish.

075312 Soffits nailed to supports

This section covers chipboard, plywood, hard board & soft board ceiling panels nailed to timber battens. Ceiling panels shall be nailed to sawn timber complying with the requirement of Specification 07422. Nails shall be punched and stopped. The sizes, patterns and spacing of battens shall be as indicated in drawings. In the instance of details not being given, the minimum sizes of battens shall be 40x50mm and the maximum spacing 600mm center to center in both direction.

The battens shall be fixed to truss or rafters in 40x50mm sawn timber suspenders that may also be used to adjust level. In the instance of the truss spacing not being close enough to keep the ceiling battens level, timber or post back supports nailed or tied to the truss shall be provided as necessary.

Ceiling soffit panels' edges shall be finished straight or chamfered as shown in drawings or schedules. Where ceiling panels edges are finished straight, the joints shall be covered with milled timber and molded lists not less than 30mm wide. The cover moulds shall follow strict and uniform pattern even if they are not to cover joints.

The joints of ceiling to wall shall be covered with molded corner lists of width not less than 50mm.

The gap to be left between chamfered panels shall be as detailed in drawings or where not shown not less than 10mm.

Unless specified as not needed, the joint between chamfered panels and walls shall be covered with molded corner lists of width not less than 50mm.

Ceiling panels less than 8mm in thickness shall not be chamfered.

075313 Suspended ceiling soffit

This section covers, chipboard, plywood, acoustic, and other ceilings suspended from supports by wires, chains and steel profiles and materials resting on metal profiles.

Support metals and suspension elements are dealt with in Section 10 (Metal Works) of this Specification.

Ceiling panels shall be accurately sized to the dimension shown in drawings. Panels with no bottom support shall be laid out and hanged from suspension, ensuring that, panels are either with no gap in between, or the gap left is as detailed in drawings.

Panels when joined, shall form true and straight lines. Where panels rest on metal supports ensure that not than 10mm width of the panel on the support side rest on the bottom support. Where up lifting of panels is likely, ceiling panels shall be securely screwed to supports.

Metal hangers and support panels are dealt with in Section 10.

075314 Milled timber soffit

Milled timber complying with the requirement of Specification 07431 in the specified type of timber shall be used for soffit and cladding.

The minimum thickness of milled timber shall be 15mm. The minimum panel width shall not be less than 60mm. Unless shown in detail drawings to be otherwise, timber boards shall be tongued and grooved and finished plain.

Timber Soffits and cladding shall be nailed to battens. Unless shown on details drawing, the battens shall be 50x50mm sawn timber, spaced at maximum 500mm center to center at directions right angle to the boards. The battens shall be securely fixed to truss members as in Specification 075312. Corners where Soffits and cladding join with

walls or other material, shall be covered in molded timber corner lists not less than 50mm wide.

07532 Milled Timber Roof Accessories

075321 Fascia and barge board

Fascia and barge board shall be produced from specified or approved milled timber complying with the requirements of Specification 07431. Fascia and barge boards shall have a minimum thickness of 20mm and width shown in drawings. The edge of fascia and barge board shall be finished chamfered.

The joints of fascia & barge board shall be spliced to show neat joints. Joints shall be filled with saw dust & glue mix before application of finish paint.

075322 Milled timber cladding

Milled timber cladding shall comply with the requirements of Specification 075313.

075323 Asbestos cement sheets external Soffits.

Comply with Specification 075313 for suspended Soffits.

Flat asbestos not less than 4mm thick complying with Specification 062432 shall be used for external Soffits.

Asbestos Soffits shall be nailed to sawn timber battens.

Unless shown on detail drawings, the battens shall not be less than 40x50mm, spaced at maximum intervals of 600mm in both directions. The battens shall be securely fixed to truss members as in Specification 075312. Corners where Soffits join with walls shall be covered in molded timber corner lists, not less than 50mm wide.

075324 Galvanized sheet ceiling Soffits

Galvanized steel Soffits shall be flat, ribbed or corrugated steel sheets in the specified thickness.

Comply with Specification 075313 for suspended Soffits.

Comply with Specification 075323 for battens and corner lists and method of construction of soffit.

07533 Milled Timber Floor

075331 Floor Boards

Milled timber complying with the requirements of Specification 07431 and not less than 20mm thickness shall be used for flooring.

The minimum width of the boards shall be 70mm. Floor boards shall be smoothly machined on the exposed face.

Boards shall be tongued and grooved joints finished and accurately matched.

Boards shall be accurately nailed on to sawn timber joists. Joint sizes and layout shall be as shown in detail drawings. If no details

are shown, the minimum sizes of joists shall be 60x100mm. Joists shall not be spaced more than 500mm apart at right angles to the direction of the boards.

Joists shall be accurately laid and embedded in concrete. The clearance between the top of the concrete and joist shall not exceed 20mm. In the instance of concrete embedding not being provided, joists shall be sufficiently braced to ensure that, there is no movement while the boarding is nailed.

Nails to boards shall be applied to tongues and well stopped. Floors shall be machined and finished smooth to be prepared for polishing and application of lacquer.

075332 Skirting

Skirting shall be produced from specified milled timber complying with the requirements of Specification 07431. Skirting shall be machined smooth finished prior to installation. Skirting shall have a minimum thickness of 20mm and width shown in drawings. If not stated the minimum width of skirting shall be 80mm.

Full length timber shall be used for skirting to the extent possible. The edge of skirting shall be chamfered to finish level with floor and wall.

Skirting shall be securely screwed or nailed to grounds in walls. Nails shall be punched and stopped.

Splices at joint shall be accurately joined to ensure that joints are not visible after finishing is applied.

07534 Doors, Windows & Wall Panels

075341 Door frames

Timber door frames shall be produced from specified timber or timber approved by the Engineer complying with Specification 07431. Door frames shall be supplied, assembled unless the supply of knock down forms is approved by the Engineer.

The heads and jambs shall be scribed and framed together with either mortise or tenon or combed joints. Transoms shall be scribed and framed to the jambs with mortise and tenon joints. Door frames shall be rebated as detailed in drawings.

Fan light openings on door frames shall be provided as detailed in drawings.

Glazing beads shall be temporarily pinned in position at the time of delivery.

Door frames shall be notched to receive iron mongery. Notching shall be executed only after the type of iron mongery and notching depth has been determined.

Door frames, unless approved by the Engineer shall be produced from full width timber and in the finished width of the wall. The minimum un-rebated jamb thickness shall be 40mm. Lists to cover joints

between frame & wall on either face of frame, shall be milled timber molded architrave not less than 50mm wide.

Assembled door frames shall have temporary diagonals and stretchers.

Door frames shall be screwed to milled timber grounds embedded in masonry. The spacing of ground for jambs and heads shall not be more than 1000mm apart. Door frames may alternately be fixed using steel band cramps screwed or nailed to the back of the frames and embedded in masonry. The distance between cramps shall not exceed 1000mm.

075342 Glazed wood doors

Glazed wood doors shall be produced from specified timber or timber approved by the Engineer complying with Specification 07431.

Glazed wooden doors shall be supplied and assembled unless supply in knock down form is approved by the Engineer.

Doors shall be produced as detailed in drawings. The side, top, bottom & intermediate rails shall be mortised and tenoned. Rails shall be produced from single width timber. Unless provided otherwise in drawings, the un-rebated sizes of rails shall not be less than 40mm thick and 100mm or such width required to insert locks.

Doors shall be rebated and notched for iron mongery. Notches on doors shall not extend beyond 10mm of the edge of the panel. If the iron mongery requires notching beyond this limit, flat metal lining shall be provided to the inner faces of the notched part in the depth and length of notching.

Notches shall be formed only after iron mongery has been examined and trial fitted on sample door.

Doors shall be rebated for glazing and beads temporarily pinned to the doors. Doors shall be hinged to frames at locations showing in schedules.

075343 Paneled wood doors

Comply with the requirements of Specification 075342 except for the following: -

- Where plywood or other panels are used in place of glazing, the rails shall be rebated to the thickness of the panels. The panels shall be tightly fixed into the frame.

075344 Match boarded doors

Match boarded doors shall be produced from specified timber or timber approved by the Engineer and complying with the requirements of Specification 07431.

Match boarded doors shall be supplied assembled. Doors shall be produced as detailed in drawings. The sides, top, bottom and intermediate rails of match boarded doors shall be mortised and tenoned.

Rails shall be produced from single width timber. Unless provided otherwise in drawings, the un-rebated sizes of rails shall not be less than 40mm thick and 100mm or such width required to insert locks.

Match board panels shall be tongued and grooved boards not less than 20mm thickness and 80mm width. The panels shall be tightly and neatly tongued and grooved and securely glued or secretly nailed to grooves in the intermediate rails.

075345 Flush wood doors

Flush wood doors for external use shall be produced from specified tongued and grooved timber complying with the requirements of Specification 07431. Flush wood doors for internal use shall be produced from timber or panel boards complying with Specification 07431 or 7432 respectively.

The type of panel boards shall be as shown in schedules or approved by the Engineer.

The finished thickness of flush doors shall not be less than 40mm.

Face panels on either face shall not be less than 8mm. Covers panels on either side if in tongued and grooved boards shall not be less than 15mm. The cores shall be in milled timber horizontal and vertical rails securely fastened to each other spaced close enough to secure rigid fixing of cover panels.

Cores may alternately be formed in honey comb plywood of thickness not less than 6mm. The panel boards shall be glued to the core securely.

Tongued and grooved timber shall be neatly and tightly nailed to the core. All outer edges of doors shall be lipped with milled timber to the width of the door and showing not less than 10mm on face.

Doors shall be rebated and notched for iron mongery. Notches on doors shall not extend beyond 10mm of the edge of the panel. If the iron mongery requires notching beyond this limit, flat metal lining shall be provided to the inner faces of the notched part in the depth and length of notching.

Notches shall be formed only after iron mongery has been examined and trial fitted on sample door.

Doors shall be rebated for glazing and beads temporarily pinned to the doors.

Doors shall be hinged to frames at locations showing in schedules.

075346 Wooden windows

In addition to the requirements of Specification 075341, 075342, 075343, 075344 for wooden doors comply with the following.

Cills for windows shall be in full width timber and extending 30mm beyond the outer face of wall. Outer faces of cills beyond the rebate for opening shall be sufficiently sloped outward. Grooves for

water drips not wider than 10mm shall be formed in the projecting section of the cills. Outer edges of cills shall be finished slightly rounded.

Mullions shall be tenoned into heads and cills.

Vent openings provided in window panels shall be in milled timber blades not less than 10mm thickness set at angles to allow sufficient air to pass through but protect rain. The vent blades shall be comb jointed and glued to the rails.

075347 Wall panels

Unless indicated in drawings, panels shall be produced from the biggest size of timber or panel board manageable for handling. Wall panels for external use may be produced out of specified milled timber capable of resisting weather changes and not absorbing moisture.

The details of construction of external wall panels shall be such that, panels are securely and tightly fixed to supports and each other.

Water drips shall be provided on panel leaves to ensure that no leakage or accumulation of water is formed.

Wall panels for internal use may be free standing panels or panels fixed against other walls.

Panels for interior use may be produced from any one of the following as specified in schedule and shown in detail drawings.

- Tongued and grooved milled timber boards of not less than 80mm width and 15mm thickness.
- Open jointed milled timber boards of not less than 100mm width and 15mm thickness.
- Block boards with specified plywood veneer exposed surface of less than 20mm thickness.
- Flush panel core construction in specified veneer plywood on both faces. The construction of the panel shall comply with the requirements of door construction.
- Any of the other joinery construction products dealt with under Specification 074.

Panels against walls shall be securely screwed to grounds embedded in walls or backings in sawn or milled timber frames.

Free standing panels shall be erected and securely fixed in accordance with approved shop drawings. Frames and braces not exposed to view shall be sawn straight edge timber frames.

Frames partially exposed to view shall be milled timber finished smooth.

Panel joints against each other or walls shall be covered with milled and molded timber architrave not less than 50mm wide.

Where panels are left open jointed, the joints shall be uniform in width through out the length or height of the panel.

07535 Cupboard & Counters

075351 Built in cupboards

Built in cupboards shall be constructed from milled timber and panel boards complying with the requirements of Specification 0743.

The construction of cupboards and their finish shall be in accordance with the schedule of joinery and detail drawings.

Cupboards shall be divided into manageable units for ease of transport. The different elements forming the cupboard units shall be neatly joined and securely fastened together in accordance with shop construction drawings approved by the Engineer.

The following are the minimum standards of material components to be used for cupboard construction.

FRAMES 40x40mm finished size milled timber if rebated on one face only. 50x50mm finished size milled timber if rebated on two faces.

BOTTOMS & DIVISIONS 20mm thick edge lipped block board with exposed faces in plywood.

REAR SIDE & TOP Unless the detail requires that, the finished face of tops, rear and sides be left as painted wall, cupboard shall be lined with 6mm exposed face smooth finished plywood. The plywood shall be securely screwed to walls.

DRAWERS Front and sides of drawers shall be built in 20mm thick milled timber. The bottom of the drawer shall be block board not less than 20mm thick. The rear shall be plywood or hard board not less than 6mm in thickness.

Unless drawer handles or knobs are indicated in the schedule, the front of the drawers shall be notched for handle. Drawers shall have milled timber, plastic or metal guide rails to each side.

Milled timber, metal or plastic drawer stopper shall be provided at the rear.

Sided box built in 20mm thick block board with the upper face finished smooth. The box shall be produced independent of the cupboards and securely fixed to cupboard timber frames.

SHELVES Shelves shall be produced in finished thickness 20mm block board with the upper face finished smooth. All edges of the block board shall be lipped in hardwood showing 10mm on face.
Shelves shall be supported on hard wood, metal or plastic supports securely screwed or nailed to the cupboard frame and divisions and capable of taking the load from the shelf.

DOOR PANEL Door panels shall be 20mm thick block board lipped on all edges. The face panel shall be smooth. Door panels shall be rebated for iron

mongery and notched for locks and handles. Metal or plastic guide rails fixed to bottom and top frames shall be provided for sliding door panels. Doors panels shall be finished flush with surface or over lapping frame.

ARCHITRAVE Architraves shall be in milled timber molded as approved by the Engineer, but not showing less than 50mm on face. Corner architrave molded to triangular face may show only 35mm on face.

SKIRTING Skirting shall comply with the requirements of Specification 075332.

Skirting shall be securely nailed or screwed to cupboard frame. Nails and screws shall be punched and stopped. Skirting may alternately be built as the bottom supporting frame, lifting bottom of cupboard, 100mm above finished floor but finished at recessed least 10mm from the face of the cupboard.

075352 Counters & cabinets

Counters and cabinets shall be constructed from milled timber and panel boards complying with the requirement of Specification 0743.

Counters & cabinets shall be divided into manageable units for ease of transport. The construction of counters and their finish shall be in accordance with the schedule of joinery and detail drawings.

The different elements forming the counter and cabinet units shall be neatly joined and securely fastened together in accordance with the shop construction drawings approved by the Engineer.

The following are the minimum standards of material components to be used for counter & cabinet construction.

FRAMES 40x40mm finished size milled timber rebated as required. 25x25mm perimeter and bracing edge frames where required for sink recessing. Sink counter shall braced at bowl& drain junction points.

BOTTOM SIDE AND DIVISION 20mm thick edge lipped block boards, faces finished in plywood.

REAR 6mm plywood panel screwed to frames, if detail requires backing.

TOP Milled timber, machine joined if more than one piece or 20mm thick block board surface finished in the specified material. The top finish shall be either Formica or plywood Veneer as specified in schedule.

DOOR AND FRONT PANEL Door panels shall be 20mm thick block board lipped on all edges. The face panel shall be smooth.
Door panels shall be rebated for iron mongery and notched for locks and handles. Metal or plastic guide rails fixed to bottom and top frame shall be provided for sliding door panels.

The finish to panels shall be either Formica or plywood veneer as specified in schedule.

DRAWERS Front and sides of drawers shall be built in 20mm thick milled timber. The bottom of the drawer shall be block board not less than 20mm thick. The rear shall be plywood or hard board not less than 6mm thick.

Unless drawer handles or knobs are indicated in the schedule, the front of the drawers shall be notched for handle. Drawers shall have milled timber, plastic or metal guide rails to each side.
Milled timber, metal or plastic drawer stopper shall be provided at the rear.
Drawers shall be boxed in a three sided box built in 20mm thick block board with the upper face finished smooth. The box shall be produced independent of the counters and cabinets and securely fixed to cabinet timber frames.

SHELVES Shelves shall be produced in finished thickness 20mm block board with the upper face finished smooth. All edges of the block board shall be lipped in hardwood showing 10mm on face.
Shelves shall be supported on hard wood, metal or plastic supports securely screwed or nailed to the counter frames and divisions and capable of taking the load from the shelf.

SKIRTING Skirting shall comply with the requirement of Specification 075332.
Skirting shall be securely nailed or screwed to frame. Nails and screws shall be punched and stopped. Skirting may alternately be built as the bottom supporting frame, lifting bottom of counters and cabinets 100mm above finished floor but finished recessed at least 10mm from the face of the cupboard.

FIXING Counter & cabinets shall be securely screwed to wall against grounds. Hanging cabinets shall be provided with metal hangers fixed on the cabinets and metal hooks securely embedded or screwed to wall.

07537 Sundry

075371 Balustrades & rails

Balustrades and rails shall be produced from specified milled timber complying with the requirements of Specification 07431 and not less than 25mm finished thickness.
Balustrade and rails shall be machine smoothed, accurately shaped, molded and grooved prior to installation.
All edges of rails shall be finished round molded. Balustrades and rails shall be securely screwed or bolted to supports. The supports shall be embedded in walls or other structure as detailed in drawings. Where balustrades and rails are to be in timber, the balustrades and rails shall be mortised and tenoned and securely glued.
Anchors to rails and balustrades are dealt with in Section 10.
Paints to rails and balustrades are dealt with in Section 12.

075372 Insulation material

Insulation materials to be sandwiched between joinery panels or joinery panel and other material shall be mineral wool, foam board, rock wool or other specified material in the required thickness glued or placed as shown in details.

Insulation material shall be laid continuous and to uniform thickness leaving no gap between joints.

076 METHODS OF MEASUREMENT

0761 General

The size of timber shown on drawings for carpentry are sawn sizes within permitted deviations.

The size of timber and panels on drawings for joinery are milled sizes within permitted deviations. The sizes of joinery and carpentry work are finished sizes within permitted deviations.

Cutting waste, halving, trimming, boring, sinking, pelleting, notching, fitting, dovetailed framing, grounding, scarf jointing, scribing, rebates, grooves, chamfers, splayed round edges, lips, tongues angles, beads, molding, returns, meters, housing, fixing and the like shall be understood as included.

Unless otherwise stated or measured separate in the bill, the following are understood as included: -

- Hardware
- Cover lists at joints and where required.
- Priming, finishing, polishing, and application of lacquer and decoration to joinery.
- Termite treatment for carpentry.
- Fixing of joinery work to walls and other structural elements.
- Carpentry ties to walls or other structure

0763 Measurement

Structural timber other than truss shall be measured by length of member without addition for laps.
Roof trusses shall be enumerated by stating type and reference to detail drawing.
Boarding, flooring, partitions, Soffits, curtain walls and the like shall be measured by area and understood as including all back frames.
Doors and opening windows on panel partitions and curtain walls shall be enumerated as extra over the item.
No deduction shall be made on curtain walls & panel partition for openings.
Fascias, eaves, barge boards, skirting and the like shall be measured by length stating girth.
Doors and windows shall be enumerated and shall be understood as including jambs frames and cover lists.
Hardware shall be understood as included if indicated so in schedule.
Built in furniture and boards shall be enumerated or measured by length stating sizes and shall be understood as including hardware unless stated as measured separate.

Hardware shall be measured separate if different type of locks, hinges, etc., are to be installed on joinery and those can not be indicated on the schedule of joinery.
Hardware may be enumerated:-

- In sets provided this is clearly drawn out on the schedule of joinery.
- Enumerated individually separated into types.
- Provided as prime costs for later selection.

08. HARDWARE (Iron Mongery)

081 GENERAL

0811 WORK INCLUDED: Furnish, deliver to site all hardware required to complete the work as indicated on the drawings or specified in the Bill Provide all trim attachments, and fastenings specified or required for proper and complete installation.

0812 RELATED WORKS DESCRIBED **ELSEWHERE**: Doors, windows, cabinets, etc., work in the Section Carpentry and Joinery of this specification.

0813 QUALITY ASSURANCE

08131 STANDARDS
Comply with the requirements of the standard of hardware as described in the Schedule of Hardware or the Bill of Quantities. The standard set in the Schedule or Bill shall form the minimum standard acceptable for the work.

08132 QUALIFICATION OF MANUFACTURERS: Products used in the work in this section shall be manufactured by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.

08133 PRODUCT DATA: Within a reasonable time and in any case prior to placing order submit the list of proposed items indicating, location of item, manufacturers specification, catalogue and other data required to demonstrate compliance with the requirements. Samples of the selected hardware shall be submitted and approved by the engineer prior to placing order and manufacture.

0814 PRODUCT HANDLING

08141 DELIVERIES AND STORAGE
Each unit of hardware shall be individually packed, complete with proper fastenings and appurtenances, clearly marked on the outside to indicate the contents.

Where suppliers pack hardware in sets of packages, such package shall clearly indicate the contents and the number in the package.

08142 PROTECTION
Hardware shall be protected during and after delivery and installation from being damaged and stained by works on other trade.

All hardware shall be kept under lock in a manner enabling easy identification until the beginning of the installation.

0815 PRODUCTS
Reference to specific proprietary products in the Bill of Quantities and Schedules are intended to establish minimum standards of utility and quality. Substitute materials may be used for the work subject to approval.

Hardware shall generally be heavy duty, durable and complying with the Schedule and as approved by the Engineer.

Hardware shall be furnished with all necessary screws, bolts, nuts, plugs and other fasteners of suitable size and type to anchor the hardware in position for long life. Fasteners shall harmonize with the hardware as to material and surface finish.

Finish of hardware shall be such that, the hardware to be installed on a unit, but supplied by different manufacturers shall have matching finish acceptable to the Engineer.

Keys shall always be in minimum duplicates or such other number as supplied by the Manufacturer.

0816 INSTALLATION

Hardware shall be properly and neatly fitted into Joinery and Metal Work.

Upon completion of the installation, all keys shall be available for verification of the proposed system of locks and once approved the keys shall be handed over.

082 MEASUREMENTS

The measurement for hardware (iron mongery) shall be understood as including notching, welding, setting in position and fixing of the complete fittings to joinery and metal work.

Hardware shall be measured in any one of the following ways: -

- Included in the fixture, if shown in detail in the schedule.
- Enumerated separated into types of fitting.
- Expressed as a set of fittings per fixture, provided the type (specification) and the number of the different fittings per fixture is indicated in the schedule.

09. STRUCTURAL STEEL WORK

091 GENERAL REQUIREMENT

0911 WORK INCLUDED

The following shall be provided as required for the satisfactory completion of the works.

- Structural steel profiles, welding consumables, bolts, nuts and washer and Grouting concrete.
- Labour for fabrication, assembly and erection.
- Equipment, tools, scaffolding necessary for fabrication, assembly and erection.

0912 RELATED WORKS DESCRIBED ELSEWHERE

Cast in place concrete	Section 031
Concrete formwork	" 032
Reinforcement	Section 033
Metal work	" 10

0913 STANDARDS

Comply with the following standards, or equivalent: -

Welded cold-formed steel Structure hollow sections	BS 6363
Weldable structure steels	BS 4360
Structural use of steel in buildings	BS 5950
Electrodes for manual metal arc welding	BS 639
Black hexagonal bolts, screws and nuts	BS 4190
Metal arc welding of carbon and carbon manganese steels	BS 4620

0914 QUALIFICATION OF WORKMEN

Metal workers, assemblers and erectors shall be skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specific requirements and the methods needed for the proper performance of the work. Through out the progress of the work provide at least one person who is trained and highly skilled in the fabrication, assembly and erection of structural steel.

The contractor is fully responsible to ensure that welders are fully suitable for the work upon which they are employed.

0915 SUBMITTAL

Within a reasonable time after signature of agreement and in any case prior to placement of order submit: -

Manufactures certificate indicating compliance of structural steel to specific dimension and strength requirements and data required for the verification of the mechanical properties of the material.

The certificate shall indicate the grade of steel and details of the mechanical analysis and chemical composition.

- Proposed methods of fabrication and assembly.
- Erection instructions.
- Information on proposed fabrication shops.

0916 TESTS

Tests to verify the grade and mechanical properties of the structural steel and welding of fabricated steel shall be carried out if required by the Engineer.

Test samples shall be those randomly selected by the Engineer.

The specific requirements of testing as detailed in BS 4360 shall be followed, to the extent determined by the Engineer.

0917 COMPLIANCE

Comply with the general submittal, substitution and sampling section of the general requirements section of this Specification.

0918 PROTECTION

Protect steel and structure and priming or other finish from damage during product transport, assembly and erection, and by work on other trade.

092 DELIVERY & STORAGE

Materials shall be stored and handled in a manner preventing deformation and damage. Structural Steel shall be stored in an off the ground position so that members are free of earth and dampness. No foreign material shall accumulate on stored Steel Structure.

Nuts, bolts, electrodes and the like shall be stored in their original packing or locked container until used.

093 PRODUCT

0931 STRUCTURAL STEEL

Structural steel plates & profiles shall be intermediate grade complying with the requirements of BS 4360.

Structural steel material shall be sound and free from internal and external defects or surface flows that might impair the section from the intended use and appearance.

The Structural Designer shall design the structural Steel in manageable units as to ease the product to transport.

0932 COLD FORMED STRUCTURAL HOLLOW SECTION

Cold-formed structural hollow section shall be intermediate grade steel complying with the requirements of BS 6363.

Cold-formed sections shall have neat finish free from defects that can be detected visually and that might impair the sections from the intended use and appearance.

0933 BLACK BOLTS & NUTS

Black bolts and nuts shall be hexagonal square or round bolts produced from mild steel. Black bolt and nuts shall comply with the requirement of BS 4190.

0934 WELDING ELECTRODES

Welding electrodes shall be material complying with the requirements of BS 639.

0935 RIVETS

Rivet shall be in mild steel or other suitable metal and alloys complying with the requirements of BS 4620.

094 EXECUTION

0941 GENERAL

The fabrication, assembly and erection of structural steel shall generally comply with the requirements of BS 5950, Part 2. Welding electrodes and procedures shall be such that, the mechanical properties of the deposited weld metal is not less than the metal to be welded.

Welding shall be executed in accordance with BS 5135 using the best modern practices.

All connections to be welded or riveted shall be securely held in position and approved by the Engineer to ensure accurate alignment, camber and elevation before any welding is commenced.

Welding and riveting shall be carried out only under the direction of an experienced and competent supervisor and after approval of trials.

The trial welds shall demonstrate to the satisfaction of the Engineer the procedure to be followed and the compliance of the welds to the strength requirement of the joints.

Records of welds and rivets showing the time of welding and the welder and supervisor shall be kept for major welds. Identification marks shall not be hard stamped.

The trial welds and rivets shall include specimen weld and rivet details, representative of the actual construction, which shall be done in a manner simulating the most unfavorable condition liable to occur in the particular work.

Shop drawings showing proposed methods of joining, welding, riveting, other connections, assembly and erection shall be submitted for the approval of the Engineer.

0942 FABRICATION

Fabrication work shall generally comply with the requirements of BS 5950 Part 2. All fabrications shall be carried out in strict conformity with the approved shop drawings, and the Engineer may give other instructions as from time to time. Material components of structural steel intended for field assembly or erection shall be properly marked to identify their location in the structure. The identification marking shall be easily visible and durable but not causing damage to the material.

Fabrication shall follow sequences, which will expedite assembly and erection and minimize field handling of structure.

Cutting shall be, by sawing, shearing, cropping or flame cutting.

Holes in structural steel shall be drilled or punched. Holes shall be drilled or punched in one operation ensuring that, the diameter of the holes is as required for the connection. No flame cutting to enlarge holes shall be made.

Holes shall not be more than 3mm larger than the diameter of the bolts. Burrs formed during punching and drilling shall be removed before assembly.

Ends of tubular profile shall be sealed. Anchors, bolts, bearing plates, etc., shall be shop fabricated and connected to the structure, if such connection does not interfere with the transport and handling of the structure.

Fastenings of bearing splices of compression members shall be done after the abutting surfaces have been brought into full contact. Bearing surfaces and surfaces in permanent contact shall be cleaned prior to assembly of members.

Structural steel shall be shop primed immediately after fabrication where necessary. Surfaces shall be cleaned and left free from loose scale, loose rust, mill, oil, water etc. before priming.

0943 ASSEMBLY & ERECTION

Components shall be assembled within the tolerances allowed in Section Seven of BS 5950 Part 2.

Adequate care shall be taken to ensure that components are not bent, twisted or otherwise damaged.

Cambers shall be provided as indicated in drawings. Holes liable to be distorted during alignment shall be enlarged by reaming if approved by the Engineer.

Bolted connection shall be drawn together. Steel packing shall be provided to close gaps between adjacent surfaces.

Washers shall be provided where slot holes are over sized or directed by the Engineer.

The levels of concrete, masonry or other structure on which structural steel is to be erected shall be examined and set accurate and leveled before erection of steel structure. Anchors and embedded connection shall be accurately set and grouted before mounting of structure.

Concrete grout shall be in the Class of the bearing concrete or C-25 minimum, if not specified. Grouted connection shall be firmly set in position, and fully cured to ensure that, no movement occurs beyond the allowed tolerance.

Temporary scaffolding, bracing and shoring shall be provided with connection of sufficient strength to bear imposed loads. Temporary guidelines shall be provided to achieve proper alignment of the structure during erection.

Temporary connection provided for erection purpose shall be made in a manner not weakening the permanent structure.

Temporary connection and supports shall be removed only after permanent members are in place and all connections made.

Structural steel work shall be securely connected to ensure that it can withstand all loading liable to be encountered during erection.

Permanent connection shall be made only after the structure has been satisfactorily aligned, leveled and plumbed.

Erections shall be executed within the tolerance limits of Section 7 of BS 5950 Part 2.

All deficiencies in structural steel work discovered before or after erection by observation, testing or otherwise shall be corrected at the contractor’s expense and as directed by the Engineer.

Protective and decorative treatment to be applied to steel structure shall be executed in accordance with Section 12 of this Specification.

Any damage to protective treatment shall be made good to the standard of the original treatment. Protective treatments shall be made good in accordance with the recommendation of the manufacturer and as approved by the Engineer.

095 METHODS OF MEASUREMENT

0951 General

The weight of steel shall be the net weight, without addition for rolling margin, welding material, open-end sealers and section joints. No deduction shall be made for holes, splay cuts, notches or the like.

The following shall be understood as included in structural steel work: -

- Cutting, drilling, end sealing, testing, riveting, welding, fabrication, hoisting and fixing in position.
- Priming and protective treatment.
- Decorative paint where shown on drawing preparation of shop drawings and erection instructions.
- Wedges, block outs & grouting
- Spacers and rivets

0952 Measurement

Stanchions, beams, trusses, purlins, ceiling support, bracing, rails, and the like shall be measured by weight identified by profiles and type of structure.

Connection plates, base plates, angles ties, brackets and the like shall be measured by weight identified by profiles.

Hold down bolts shall be enumerated stating sizes and shall be understood as including bolts, anchors and spacers.

10. METAL WORK

102 GENERAL REQUIREMENT

1021 Work Included

Provide all metal, ties, fasteners, labour and the necessary tools for the satisfactory fabrication and installation of metal works as indicated in drawings and schedules or specified herein.

1022 Related Works Described Elsewhere

Carpentry & Joinery	Section 07
Hard Ware	Section 08
Structural Steel	Section 09

1023 Quality Assurance

10231 Standards

Comply with the following standard.

Hot dip galvanized coating on iron and steel articles	BS 729
Anodic oxidation coating on aluminum	BS 1615
Anodic oxide coating on Aluminum for external architectural application	BS 3987
Wrought steel for mechanical & allied engineering purposes	BS 970

10232 Qualification of manufacturers

Products used in this work shall be produced by manufacturers with adequate experience and successful reputation regularly engaged in the manufacture of similar items.

10233 Qualification of workmen

Metal workers shall be skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods required for the proper performance of the work.

10234 Submittal

Within a reasonable time after signature of agreement and before placing order, submit the following for the approval of the Engineer.

- List of materials to be furnished under this Section.
- Manufacturers specification indicating mechanical properties of materials, coating standards, profiles shapes and any other data required to ascertain compliance with the requirement.
- Names and locations of proposed fabrication shops. Evidence of their capability to fabricate the metal work under consideration shall be produced if required by the Engineer.
- Shop drawings and further details showing construction details, proposed methods of fixing and installation procedures.

10235 Compliance

Comply with the submittal, substitutions and sampling section of the General Requirements section of this Specification.

10236 Protection

Metal work shall be adequately protected during transport and after installation from damage that may be caused by work on other trade.

10237 Samples

Samples of each type of work in its component material, fabricated, assembled, fixed and finished form shall be produced as required for approval by the Engineer. All materials and work thereafter shall in all respects comply with the approved samples.

Samples shall be maintained and kept in their original condition until permission to remove them is granted by the Engineer.

1024 Delivery & Storage

Materials and fabricated products shall generally be protected from damage during transit and storage. Items shall be stacked in enclosed spaces, off the ground to ensure protection from dampness and contact with foreign materials.

Items shall be stacked in an orderly and neat manner so that no damage is made to coatings & hardware. In the instance of hardware being liable to be damaged by stacking, it shall be removed and stored separate in packing.

103 PRODUCT

1031 General

Materials shall generally be smooth, free from surface blemishes, including pitting, seam marks, roller marks, and roughness and inscribing.

The minimum standards of products are to meet or exceed the individual product specification hereunder.

1032 Steel products

Steel profiles shall be manufactured in grade of steel complying with the requirement of BS 4360 and BS 6363.

Steel products shall be one of the following as specified by the Engineer or that exceeding this standard.

- Black steel to be primed during fabrication and surface treated after installation.
- Hot dip galvanized steel complying with the requirements of BS 729.
- Pre-coated steel profiles, the coating of which satisfies the requirements of BS 2569 for the protection of the material against atmospheric corrosion.

The coating shall also satisfy colour and texture requirements as required by the Engineer.

1033 Aluminum Products

Aluminum sections and preformed profiles shall comply with the relevant section of the following Standards.

Wrought aluminum and aluminum alloys for general engineering	BS 1470
Wrought aluminum and aluminum alloys for purposes:- plate, steel and strip.	
Generally Engineering purposes bars, extruded round tubes and sections.	BS 1474
Liquid organic coats for application to aluminum alloy extrusions, sheets and performed sections	BS 4842
Anodic oxidation coatings on aluminum and its alloys	BS 1615
Anodic oxide coatings on wrought aluminum for external architectural application.	BS 3987

1034 Nuts, bolts, screws and fasteners

Bolts, nuts and screws shall generally, be coated or produced from non-oxidizing metal. Screws, bolts and nuts shall be those recommended by the fabricators of the metal work.

Fasteners & cramps shall be galvanized or metal coated for protection against corrosion.

1035 Welding electrodes

Comply with the requirements of the Structural Steel section of this Specification.

104 EXECUTION

1041 Fabrication

Metal work shall be fabricated to be rigid, neat in appearance and free from defects, warp or buckle. Metals shall either be preformed or formed accurate to required profiles and sizes.

Metal works shall generally be assembled and fitted in the place of fabrication. The specific approval of the Engineer is required for the assembly of metal work at site. The various components of the cut metal work shall be accurately marked for identification, if assembly on site is allowed.

Metal units to receive hardware shall be prepared at the place of fabrication by cutting out, reinforcing, drilling and tapping. The installation procedure for hardware shall be as directed by the manufacturer.

Samples of installed hardware shall be inspected and approved by the Engineer prior to the fixing of hardware on metal work.

Metal work requiring priming shall be primed at the place of fabrication. The surface of metal shall be coated in zinc chromate or red oxide primers complying with ES D C1 001 & 010 respectively. Priming coats shall be applied by brush or gun sprayed to give adequate thickness coat and to fully fill pores. Priming shall be well worked into the surface, angles, corners & joints.

1042 Erection

Examine the locations where metal work is to be fixed and ensure that satisfactory preparations are made and necessary conditions fulfilled for the fixing of metal work.

Metal work shall generally be fixed in accordance with the manufacturers or fabricators instructions. Metal work shall be placed accurately in position, aligned, plumbed and leveled and temporarily braced securely until permanent fasteners are set.

Temporary braces and fasteners shall be removed only after metals work is securely fixed. Adequate care shall be taken to ensure that temporary braces do not damage the surface.

Where fixing lugs are embedded in concrete or masonry, the class of concrete to be used shall be that of the concrete against which fixing is to be done. If fixing is against other masonry, C-25 concrete shall be used.

1043 Metal doors, windows and curtain walls

10431 General

Window, doors and curtain wall shall confirm to the specified material and produced to sizes shown on drawings and schedules.

Profiles shall be cut and fitted to the required length and welded or mechanically joined along the entire line of contact.

Joints shall be watertight. Fixed and opening panels exposed to weather shall be provided with weather strips, ensuring that, the strips are fixed continuous enough to be fully watertight.

Fixing lugs and anchors in masonry shall be located at hinge and strike levels. Fixing lugs shall be provided in sufficient number but not less than two on a side at any instance.

Glazing beads shall be temporarily fixed to doors, windows and curtain walls. Where panels are to replace glazing, adequate care shall be taken to ensure that, the gap left has sufficient width and clearance for the installation.

10432 Casement doors & windows

Casement doors & windows shall be side, bottom or top hinged produced from any one of the following.

- Galvanized steel profiles
- Black or preprinted mild steel profile
- Extruded aluminum profiles

Hardware to casement doors and windows shall be as shown in the schedule of door and windows or specified in drawings.

10433 Sliding glass doors & windows

Sliding glass doors and windows shall be fabricated from extruded aluminum profiles and stainless steel tracks. Fixed and sliding interlocks shall be water tight and weather-stripped.

Sliding and fixed panels shall be removable for glazing replacement, but no panel shall be removable from outside when locked. Sliding doors and windows shall be fixed in strict conformity with the manufacturers' guide.

10434 Heavy duty sliding door

Heavy-duty sliding doors shall be built in profiles produced from steel complying with the requirements of BS 4360. The steel to be used shall be black or pre-coated as specified in drawings and schedules.

Guides and guide tracks and roller tracks shall be in mild steel in the sizes specified in the schedule.

Rollers shall be heavy duty and produced from stainless steel. Rollers shall be provided at top and or bottom as detailed in drawings.

The rollers and guide tracks shall be securely embedded in concrete or welded against steel to ensure that, the imposed load from the door during movement is well taken.

Sufficient bracing and frames shall be provided to ensure that, the steel metal panels are firmly set in position and no displacement or warping is noted during heavy punching.

Accessories and hard ware shall be as detailed in schedule.

10435 Louver windows

Louver windows shall be produced in standard 152mm louver jamb sets in mill finish aluminum including handles from inside and head and cill weather strip.

1044 Sundry Items

10441 Security grills

Security grills shall be produced from mild steel black, galvanized or pre-coated solid plates or hollow and solid profiles.

Security grill profiles shall be welded or fastened to each other and fixed to supports as detailed in drawings.

10442 Guard rails

Guard rails shall be produced from mild steel black, galvanized or pre-coated solid plates or hollow and solid profiles or extruded aluminum profiles.

Guard rail profiles shall be securely fastened to each other by bolting, screws or welding as appropriate to the material and details in drawings.

Guard rails shall be fastened to support, securely embedded in concrete or welded to backing material.

Where timber rails and balustrades are built with metal rails such units shall be securely fixed to the metal.

10443 Soffit and wall fixers

Soffit and wall fixers shall be produced from mild steel black, galvanised or precoated steel and extruded aluminium performed for the intended purpose.

Profiles shall be securely welded or fastened to each other and to their supports as detailed in drawings. Adequate care shall be taken to ensure that sufficient support area is given to the material they support.

10444 Wire netting & fly screen

Fly screen & wire netting shall be netted wire produced from galvanised steel or aluminium wire. The mesh sizes and wire thickness shall be as indicated in drawings or schedule.

The mesh for fly screen shall not be more than 10mm and produced from material not less than 18SWG. Mesh wires and fly screen shall be fixed to doors & windows in milled molded timber or metal beads. Fly screen and wire netting beads shall be finished painted as the panels on which they are fixed.

10445 Corner protection

Corner protection produced from mild or galvanised steel or aluminium angle profiles not less than 30x30mm shall be securely screwed or embedded to angles of materials to be protected. Fasteners for embedding corner protection shall be galvanised, dovetailed steel embedded in concrete to the corners of the material to be protected.

Corner protections shall be fastened at distances not exceeding 500mm center to center.

Mild steel and galvanised corner protections shall be finished painted in three coats of synthetic enamel paint.

10446 Grating & pit covers

Grating shall be built in mild or galvanised steel profiles, chequered or slotted plates as detailed in drawings.

Individual units shall be cut and fitted as shown in drawings.

Units shall correctly match adjacent panels and support in all directions. Gratings shall be designed to resist the load imposed on them. Grating required to be removed for clearing or otherwise shall be paneled in manageable sizes, and provided with handles or leverage slots to ensure easy handling.

Mild steel grating shall be finished primed and painted as specified in schedule.

10447 Ladders

Ladders shall be produced from black mild or galvanised hollow or solid steel.
Ladders shall be securely welded or concrete embedded to the support. Ladders in open area shall be built clear of the ground to ensure avoidance of contract with earth. Ladder shall extend sufficient height

over the platform, and shall be bent over for continuity with other rails or ladders. Ladders shall have sufficient clearance from the backing to ensure easy ascent and descent. Steps of ladders shall be securely welded to the verticals. Ladders shall be primed and finished in three coats synthetic enamel paint.

105 METHODS OF MEASUREMENT

1051 General

The weight of metals shall be the net weight without addition for rolling margin, welding material, open and covers and section joints and without deduction for holes, splay, cuts, notches or the like.

The following shall be understood as included: -

- Chiseling, cutting, welding, riveting, shaping, grinding, drilling, bolting, countersinking, assembling, fixing and the like.
- Protective treatment.
- Decorative paint.
- Frames, beads, linings, anchor brackets, grounds.
- Hardware unless indicated as measured separate.
- Preparation of shop and erection drawings.

1052 Measurement

- Floor plates, duct covers, suspension profiles, ladders metal corner protection and linings shall be measured by length stating sizes.

- Stairway and balustrade rails shall be measured by length stating girth.

- Protective grills fixed to windows and doors shall be measured by area.

- Doors and windows shall be enumerated stating sizes.

- Curtain walls shall be measured by area.

- Louver frames shall be enumerated in pairs stating number of blades.
- No addition or deductions shall be made for deviation in measurement of up to 50mm in length, width and height.

111 PLASTER & POINTING

1112 GENERAL REQUIREMENT

11121 Work Included

Provide cement, lime, aggregate, labour, equipment and tools for plaster & pointing as required for the satisfactory installation of the works.

11122 Related works Described Elsewhere

Cast in place concrete	Section 031
Concrete formwork	Section 032
Masonry Works	Section 04
Floor and wall finishing	Section 112

11123 Quality Assurance

111231 Standard

Comply with the following standard

ES C D5 201	General requirement, Portland cement, ESI
ES C D5 003	Hydrated lime, ESI.
BS 1198	Sand for internal plastering with gypsum plasters.
BS 1199	Sand for external rendering and internal plastering with lime and Portland cement.
ASTM C94	Mixing water for concrete.
BS 1369	Metal lathing for plastering

111232 Qualification of Workmen

Pavers and plasterers shall be skilled workmen who are thoroughly trained and experienced in the necessary crafts. In addition to these requirements assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the trades men in the selection of materials and execution of the works of this section.

111233 Submittals

Submit product data for approval by the Engineer immediately after signature of agreement indicating the sources of cement, sand and aggregate. Submit manufacturers certificate showing properties of cement & lime. Submit test certificates for aggregate or carry out tests for the compliance of the aggregate to BS 1198 & BS 1199.

111234 Compliance

Compliance with the submittal, substitution and sampling sections of the General Requirements of this Specification

111235 Delivery & storage

Comply with the requirements of the delivery & storage of cement and lime in the Masonry section of this Specification.

1113 PRODUCTS

11131 Cement

As in Section 04341.

11132 Lime

As in Section 04341.

11133 Aggregate

Aggregate for plaster and pointing shall be naturally occurring sand or crushed aggregate. The aggregate shall be hard, clean, free from adhered coatings with no clay content.

Aggregate shall be free of harmful organic and inorganic material that may affect the setting, strength, durability and appearance of render or undercoat and material in contract with it.

The clay and fine silt content of aggregate shall not exceed 5% by weight.

The grading of aggregate for undercoats and fine coats shall comply with the requirements of BS 1199 Tables 1 & 2 respectively.

The grading of aggregate for gypsum plaster shall comply with the requirement of BS 1198 Table 1.

11134 Gypsum for plaster of Paris shall comply with the requirement of BS 1191 class A.

11135 Water

Comply with the requirement of water in the in-situ cast concrete section of this Specification.

11136 Plaster lath

Plaster lath shall be made from mild steel sheet free of flaws, defects and rough edges. Plaster lath shall be expanded metal, perforated black sheets or dovetailed type made by pressing steel sheets. The size of the holes in the sheets or the aperture made by the mesh shall not be less than 0.5mm. Plaster lath shall be galvanized steel or mild steel protected with one coat of anti-rust primer.

11137 Mortar

111371 Mix proportion

Refer to the Specification under execution for the mix proportion of each type of mortar.

111372 Mixing mortar

The ingredients of mortar shall be measured in accurate gauge boxes for volume. Mortar shall be mixed in an approved mechanical batch mixer. Dry ingredients of mortar shall in the first instance, be mixed until there is a uniform consistency in colour. Water shall be added and the mixing continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. In no case shall mixing be carried out for less than two minutes after adding water. Sufficient water shall be added to the mix to produce a pure consistency.

In instances where hand mixing is unavoidable, the cement content shall be increased by 10%. The dry and wet mixes shall be turned over sufficient number of times to produce the respective consistencies as required by batch mixers. Cement mortar shall be

used within half hour of adding cement to the mix. Compo-mortar shall be used within one hour of adding cement to the mix.

1114 EXECUTION

11141 General

Surfaces to receive plaster, pointing or screed shall be thoroughly cleaned, inspected and wetted before application. Concrete surfaces shall be rubbed with cement slurry and angles of concrete & masonry surfaces dusted with cement to give additional strength.

All chases shall be cut out, services installed and chases made good prior to application of plaster, pointing, and screed. Hacking on concrete and masonry surfaces shall be carried out by approved means.

Joints shall be raked out to a minimum depth of 10mm to form proper key if not specified under the respective masonry type to receive plaster or pointing finish.

Where making good plaster, pointing or screed is required, the surface shall be cut out to a rectangular shape and the edges, cut out to form dovetail key. Cracks, blisters and other defects shall be cut out and made good.

Dubbing out shall be made in the same material as plaster. Dubbing out to make up uneven surfaces of walls, floors etc., shall be made before the application of the undercoat.

Making good of plaster and dubbing out shall be finished flush with face of surrounding plaster.

Plaster & pointing applied to different materials shall be raked out to a minimum depth of 10mm at the joints finished and pointed in cement mortar. Where the joints between different materials are tied in hoop iron the plaster or pointing may be carried through the joints.

Plaster, pointing and screed containing cement shall be wetted for a minimum of seven days after the application of the coat.

Plaster work shall be applied to specified thickness and truly level and plumb.

11142 Two coat plaster

Plaster shall be applied in two coats with the following mix proportion for mortar. The aggregate for mortar to be used shall comply with table 1 of BS 1199 for lime plaster and BS 1198 for gypsum plaster.

First coat: 1 Part cement to 2.5 parts aggregate by volume.

Second coat: 1 Part cement to 1 part lime and 6 parts of aggregate by volume.

Or

1 Part of cement to 4 parts of aggregate by volume.

The lime shall be replaced by gypsum where gypsum plaster is to be used. The first coat to be applied to a thickness of 5mm shall be spread by trowel, struck off level, and allowed to cure for 24 hours.

The first coat shall be wetted and the plumb line for the second coat established after 24 hours. The second coat of plaster shall be applied within 4 hours of the establishment of plumb line on the surfaces.

The second coat shall be applied by trowel to a maximum thickness of 12mm. This coat shall be allowed to cure for a minimum of 21 days before further finish is applied.

11143 Fine Coat Lime Plaster

The final fine coat plaster to be applied by trowel and finished level and smooth to a maximum thickness of 3mm shall consist of 1 part of lime to two parts of fine aggregate complying with table 2 of BS 1199. The fine coat shall be left for a minimum of 28 days with no further finish applied.

11144 Fine Coat Gypsum Plaster (Plaster of Paris)

The final fine coat gypsum plaster to be applied by trowel shall consist of one part of gypsum to three parts of lime putty, applied to a thickness of 3mm. The plaster shall be finished truly level and smooth. The plaster shall be allowed to cure. No finish shall be applied to gypsum plaster before the age of 28 days.

The surface of gypsum plaster is not to be sanded for the application of further finish.

11145 Fine Coat Cement Plaster

The final coat of cement plaster to be applied on two coat plaster shall consist of one part of cement to two parts of fine aggregate complying to BS 1199 by volume applied by trowel to a maximum thickness of 3mm. The surface shall be finished truly level and smooth. This coat shall be cured by watering for a minimum of seven days and allowed to cure for at least 28 days before further finish is applied on it.

11146 Render Coat

The final coat of render to be applied on two coat plaster shall consist of one part of cement to two parts of lime and five parts fine aggregate complying with BS 1199 table 2. The render coat shall be manual or machine sprayed and finished truly level.

Render coat shall be wetted for a minimum of 7 days and left to cure for at least 28 days before further finish is applied on it.

11147 Float Finish

Float finish shall be applied to concrete surfaces that are to receive no plaster coat. The surface of concrete shall if necessary, be chased out and made good to true and even surface.

A rendering coat of 1 part of cement to two parts of fine aggregate by volume complying to BS 1199 Table 2 shall be applied and the surface floated.

Cement dust or cement paste shall be applied to the floated surface to form the final even surface. Cement floated surfaces shall be wetted for seven days and allowed to cure for at least 28 days before further finish is applied.

11148 Cement Pointing

The mortar to be used for pointing shall be in 1 part of cement to two parts of fine aggregate complying with BS 1199 of Table 2.

The raked out joints of walls shall be flush or recess pointed as indicated on drawings. Flush pointing shall be finished even & level with the surface of the wall material.

Recess pointed surfaces shall have the raked out joints pointed with struck weathered horizontal joints and square recessed vertical joints with a depth of not less than 5mm or as shown on drawings.

Pointed surfaces shall be cement dusted or cement paste applied to form final even & smooth surfaces. Pointed walls shall be wetted for at least seven days and allowed to cure for at least 28 days before further finish is applied.

1115 Methods of Measurement

- Plasterwork shall be measured flat with out addition for edges and returns.
- Plaster to ribbed or corrugated surfaces shall be measured flat.
- Curved, spherical and conical surfaces shall be measured along the surface.
- Internal and external surfaces shall be measured separate.

The following are understood as included: -

- Preparing background like hacking, racking out joints grouting, bedding, jointing and key formation.

- All work in narrow widths, corners, angles & openings.
- Recessing of joints in plaster.
- Plaster shall be measured in successive coat with two backing coats measured as an item and the final coat measured separate.

- Plaster work shall be measured by area identified by the surface of the material it is to be applied to.

112 FLOOR & WALL FINISH

1121 DEFINITIONS

1122 GENERAL REQUIREMENTS

11221 Work Included

Provide cement, lime, aggregate, tiles, admixtures, and other finishing materials, labour and tools for the satisfactory completion of the works and polishing at the end of the work.

11222 Related Works Described Elsewhere

Cast in place concrete	Section 031
Concrete formwork	Section 032
Masonry works	Section 04
Plaster & Pointing	Section 111

11223 Quality Assurance

112231 Standard

Comply with the following standard.

ES C D5 201	General requirement, Portland Cement, ESI
ES C D5 003	Hydrated lime, ESI.
BS 1198	Sand for internal plastering with gypsum plasters.
BS 1199	Sand for external rendering, internal plastering with lime and Portland cement and floor screeds.
ASTM C94	Mixing water for concrete.
DES C.D3.303	Terrazzo tiles, general requirement, ESI.
DES C.D3.302	Cement flooring tiling, general requirement, ESI.
DES C.D4.052	Glazed ceramic tiles, general requirements, ESI.

112232 Qualification of workmen

Pavers shall be skilled workmen who are, thoroughly trained and experienced in the necessary crafts. In addition to these requirements assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of materials and execution of the works.

112233 Compliance

Comply with the submittal, substitution and sampling section of the General Requirements Section of this Specification.

112234 Delivery & Storage

Comply with the requirements of the delivery and storage of cement and lime in the Masonry section of this Specification. Materials like tiles, skirting, etc. packed at place of production shall be delivered in their original packing and shall remain sealed until used.

Packages shall be clearly labeled with the manufacturers name, contents, sizes and quantities. Precast and cut to size elements shall be properly stacked with necessary precaution taken during transport.

Precast elements and packed materials shall be neatly stacked in a lockable shed. They shall be prevented from contamination and adverse weather. The materials shall always be stored off the ground to avoid contact with soil.

1123 PRODUCTS

11231 Cement, aggregate & water

Comply with the requirement of Section 1113 for cement, aggregate and water.

White cement: White cement to be used for grouting tiles produced from hydraulic lime (white rock of suitable composition) shall be non-staining (free from iron-oxide) and in light colour.

White cement shall have strength equal to Portland cement as required by ES C.D5.201.

11232 Terrazzo tiles

Terrazzo tile paving and skirting shall be precast or in-situ cast elements complying with the requirement of DES C.D3.303. Terrazzo tile shall have a minimum topping of two parts of marble or granite chipping from an approved quarry and one part cement. The minimum grading of the chip shall be 5mm.

11233 Precast cement tiles

Precast cement tile flooring and skirting shall comply with the requirements of DES C.D4.052. Cement tiles shall be produced from naturally occurring or crushed aggregate and sand mix. All tiles shall be square and straight edged.

The minimum thickness of precast tiles shall be 20mm. Pigments for colouring the wearing surface of cement tiles shall be uniform through out the surface and complying with BS 1014.

11234 Slip resistant tiles.

Slip resistant tiles shall be precast cement tiles complying with the requirement of Section 11233, but having enough grips for slip resistance.

11235 Marble tile

Marble tile shall be in accordance with the qualities, colour, textures and types indicated on drawings. Marble tile shall be supplied from manufacturers and approved by the Engineer.

Marble tiles shall be straight edged, smooth surface, (weathered and throated for cills & copping) and supplied in the specified thickness.

11236 Marble chip flooring

Marble chips of qualities, colour, texture & type indicated on drawings and approved by the Engineer and having thickness of not less than 20mm and irregular shape shall be used for marble chip flooring. The smallest dimension of the irregular shape shall not be less than 100mm. The total thickness of the floor shall not exceed 50mm.

The exposed surface of mortar finish to marble chip shall not exceed 1:3 proportions at the maximum.

11237 Ceramic & mosaic tiles

Ceramic tiles shall be glazed tiles of approved colour, texture and sizes. Ceramic tiles shall be 6mm thick for walls and not less than 15mm thick for floors. The edges of ceramic tiles for walls shall be cushioned. The edges of ceramic tiles for floor shall be straight.

Mosaic tiles shall be glazed tiles of approved colour and produced in regular square or hexagonal sizes not exceeding 25mm in dimension of each side.

11238 PVC tiles

PVC tiles shall be smooth surface, straight grain, manufactured from vinyl resin asbestos fiber fillers, pigments and plasticizers resisting to a maximum sub-floor temperature of 27 degrees centigrade. The tiles and skirting shall be resistant to household oil and acids.

The thickness, size and colour of tiles shall be as indicated on drawings or approved by the Engineer.

The glue for fixing PVC tiles and skirting shall be matching glue in accordance with the Instruction of the manufacturer.

11239 Carpet tiles

The sizes, quantities, colour and method of fixing for carpets and carpet tiles shall be as indicated on drawings or described in schedules.

1124 EXECUTION

11241 General

Surfaces to receive floor and wall tile or screed finish shall be thoroughly cleaned, inspected and wetted before the application of the finish. Concrete surfaces shall be rubbed with cement slurry.

All chases shall be cut out, services installed, and chases made good prior to application of finish material. Hacking on concrete and masonry shall be carried out using appropriate means.

Where making good is required for sub-floor and finished surfaces, the surfaces shall be cut out to a rectangular shape and the edges cut out to form dovetail key. Cracks, blisters and other defects shall be cut out and made good. Cutting out to replace tiles shall always be done to the full size of the tiles, so that no under sized tiles are replaced, except at edges where such cut tiles are of the same size and pattern as the un-removed tiles.

11242 Cement, Terrazzo, Marble, Ceramic and Mosaic Floor Tiles

Tiles shall be thoroughly soaked in water for a minimum of 15 minutes before laying and taken out just before use.

Cement slurry bond coat shall be scrubbed to prepare slab prior to placing mortar bed. The mortar bed composed of 1 part cement to three parts of aggregate complying with BS 1199 Table 1 shall be immediately applied after application of slurry bond coat and spread evenly.

Spread setting coat on the mortar bed and set the tiles. The tiles shall be laid over the screed with continuous joints. Tiles shall be accurately cut and fitted to doors, wall ends, opening & projections.

Tile joints shall be grouted with the setting coat mortar. Finished floor shall be perfectly true and level or laid to falls as shown on drawings.

Tiles shall be left undisturbed for 24 hours. Tiles shall be topped with cement fine aggregate mortar mix 1:3 to a minimum thickness of 5mm distributed uniformly.

The flooring shall be wetted for seven days and left to cure for 28 days. The topping shall be machine ground with carborundum stone to clear the topping and expose the tile. The ground tile shall be cleaned off dust and polished at completion of work.

11243 Cement Screed floor finish & PVC backing

Cement slurry bond coat shall be scrubbed to prepare slab prior to placing mortar bed.

The mortar composed of 1 part cement to three parts aggregate complying with BS 1199 Table 1 shall be immediately applied after application of the slurry bond coat and spread evenly.

The finishing coat composed of 1 part cement and three parts aggregate complying with BS 1199 Table 2 and to a thickness of 10mm shall be spread on the mortar bed evenly.

The finish coat shall be spread with cement powder and trowel led to an even and level surface. Surfaces to be finished smooth shall be wood floated. Joints between screed panels shall be accurately located before the spreading of the undercoat. The joints shall be in fiber board of 20mm thickness against which the panels are to be cast.

The soft board shall be removed while the screed is wet and the gap filled with bitumen, fine aggregate mix to the top of the undercoat. The joint to the top of the finish coat shall be flush pointed with 1:2 cement, fine aggregate mix.

11244 Marble Chip Flooring

Marble chip shall be thoroughly soaked in water for a minimum of 15 minutes before laying and taken out just before use.

Cement slurry coat shall be scrubbed to prepare slab prior to placing mortar bed. The mortar bed composed of 1 part cement to three parts of aggregate complying with BS 1199 Table 1 shall be immediately applied after application of slurry bond coat and spread evenly.

The setting coat composed of 1 part cement and three parts fine aggregate shall be spread on the undercoat and the marble chips set in to even and level surface. The finished surface shall be left undistributed for 24 hours. The surface shall be topped with cement fine aggregate mortar mix 1:3 to a minimum thickness of 5mm distributed uniformly.

11245 Earth floors

Earth floors shall be constructed on compacted and leveled earth sub-floors. The material for the screed shall be made by mixing non-expansive clay with water to form a consistent mix of suitable workability.

The mix shall be spread on the sub-floor and trowel led with a wooden float to a finished thickness of 20mm.

11246 PVC tiles & skirting

PVC tiles and skirting shall be laid on properly finished, cured and aged floor screeds with approved glue in accordance with the manufacturers instructions. PVC tiles and skirting shall be dusted in saw dust and polished to remove glue and other stains on surface.

PVC tiles shall not be laid before two coats of paint are applied to wall and ceiling surfaces.

11247 Ceramic & Mosaic Wall Tiles

Wall tiles shall be bedded with straight joints in patterns as shown on drawing or directed by the Engineer. The mortar to be used for wall tile bedding shall be 1 part cement and two parts fine aggregate.

Tiles shall be left undisturbed for 24 hours and wetted for 7 days. The joints of wall tiles shall be grouted in white cement and cleaned down at completion of work.

Tiles shall be washed down and rubbed with clean soft cloth to produce smooth & shiny surfaces.

11248 Dividing Strips for floors

Where floors are to be divided by strips of metal, rubber or plastic lining such linings shall be accurately laid on the topping coat of the screed or before floor tiles are laid. The top of the dividing strips shall be finished accurately even and level with the finished floor level.

11249 Copings, Cills, Steps & Risers

Copings, cills, steps & risers produced from marble & terrazzo, shall comply with the requirement of these materials for production & execution.

Copping, cill, steps & risers produced from concrete shall be C-25 concrete quality complying with the requirements of precast concrete works.

Copings, cills, steps & risers produced from stone shall be sound dressed stone bedded and laid in accordance with the requirements of the laying & bedding of other cills.

Copping and cills shall be throated and weathered as detailed on drawings and laid to required falls.

112410 Stone Paving

Stone paving, specified as dressed or rough dressed, shall be fair chiseled or dressed out of sound stone. It shall be laid on compacted earth/fill and 10mm sand bedding and joints pointed with cement, sand, mix 1:2 mortar or filled with clear natural sand. The thickness of the bedding stone shall be a minimum of 100mm at the smallest point.

112411 Concrete Paving

Concrete in-situ or precast paving shall be in class C-20 concrete, complying with the general requirements of concrete and precast concrete.

The paving in specified thickness shall be laid on compacted earth/fill and 50mm sand or blinding concrete bedding and joint pointed with cement mortar or filled with clear natural sand.

1125 METHODS OF MEASUREMENT

11251 General

Finishing work shall be measured flat without addition for laps or seams.

Finishing on corrugated works shall be measured flat.

Curved, spherical and conical surfaces shall be measured along the surface.

Internal and external works shall be measured separate.

Preparing back grounds like hacking, racking out joints, grouting, bedding, jointing, rubbing and priming shall be understood to be included.

The following shall be understood as included: -

- All work in narrow widths, corners, angles or openings.
- A recessed joint in finishes.
- Cleaning, polishing and other treatment to surfaces prior to and at the end of work.

Measurement

The following shall be measured by area specifying material, size and thickness: -

- All finishes to floors specifying
- All finish to walls except skirting, copping and cills
- Risers, treads and landing to stairs.

The following shall be measured in length specifying materials size and thickness.

- Skirting
- Cills and copings
- Dividing strips in floors. (expansion joints filled with sand & bitumen) included in floor.

12. PAINTING

122 GENERAL REQUIREMENT

1221 Work Included

Provide all backing and painting material, necessary labour and tools for the preparation, priming and painting of surfaces and cleaning up at work completion.

1222 Related Works Described Elsewhere

Concrete works	Section	03
Masonry works	"	04
Carpentry works	"	07
Hardware	"	08
Structural Steel Work	"	09
Metal Work	"	10
Finishing	"	11
Glazing	"	13

1223 Standards

Comply with the following standards:

Glue size for decorators use	BS 3357
Lead based priming paints	BS 2523
Metallic zinc rich priming paints	BS 4652
Mineral solvent for paints	BS 245
Ready mixed aluminium priming paints	BS 4756

1224 Qualification of Workmen

Painters shall be skilled workmen who are thoroughly trained and experienced in the necessary crafts. In addition to these requirements, assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the trade's men in the selection of materials and execution of the works of this section.

1225 Submittal

Within a reasonable time and in any case prior to placement of order submit the following for approval.

- Manufacturers name of paint stating type of material, brand name, intended use, specification of paint, coverage and other relevant data required to confirm compliance with the specific requirements.
- Recommended thinners and dryers and their method and proportion of use.
- Paint strippers, abrasive papers, cleaning agents, etching solutions, stopping, knotting and fillers shall be as recommended by the paint manufacturer.

1226 Compliance

Comply with the submittal, substitution and sampling section of the General Requirements Section of this Specification.

1227 Protection

Use all means necessary to protect the materials of this work before, during and after installation and to protect the work and materials of other trade. Scaffolding, trestles, other erections and protecting covers shall be placed to provide the maximum protection to the existing structure and to permit normal functioning, should area to be painted be under occupancy.

Catalogues showing the colour, shed and application instructions and method of thinning and priming surface are to be submitted with the product.

Paint materials shall be stored in enclosed spaces, secured from fire risks.
Paint materials shall be stored on shelves, or ramps clearly off the ground.

Paint containers shall be stacked in a manner preventing damage to the containers and deterioration of paint materials. Paint materials shall remain sealed until used.

Opened container shall be closed tight to ensure sealed conditions if paint has been partially used.

1225 PRODUCTS

12251 General

The specification of products hereunder is a general guide for paints. The specification of the manufacturer approved by the Engineer shall govern for selection of material and coatings. Paint materials shall generally be obtained from approved suppliers only. Paint supplies shall be limited to the smallest possible number of manufacturers.

Surface sealers, primers and under coats shall generally be in accordance with the paint manufacturer's recommendation.

Paint strippers, abrasive papers, cleaning agents, etching solutions and fillers shall be as recommended by the paint manufacturer.

Paints shall be such that stirring produces a smooth uniform mixture which works well under brush.

1232 Glue

Glue for sizing for surfaces to receive paint shall comply with the requirements of BS 3357 and as recommended by the paints manufacturer depending on the surface to be sized.

1233 Priming paints

Oil based priming paints shall be applied to surfaces under ready mixed oil base paints or conventional hard gloss paints.

Aluminium priming paints for wood work shall be for brush application. The primer shall comply with the requirements of BS 4756. Metallic zinc rich priming paint complying with the requirements of BS 4652, shall be applied to iron and steel surfaces, which have been blast cleaned to ensure close electrical contact and for touching up damaged zinc coatings.

Primers shall be such that, they do not loose their property for a period of not less than six months in their original sealed conditions. The properties of oil based primers and the proportion of ingredients shall be as shown in the formulation table of BS 2523.

1234 Oil paints

Oil paints shall be linseed oil based complying with the requirements of BS 2525-32 and obtained from approved manufacturers.

1235 Plastic emulsion paint

Plastic emulsion paints shall be obtained from approved manufacturers. Plastic emulsion paints shall be selected for interior and exterior work and where special applications of water proofing qualities are required.

1236 Special paints

Special paints like black board, traffic, quick drying lacquers, etc., shall be supplied from manufacturers approved by the Engineer. The paints shall fully comply with the requirements of quick drying, high resistance, etc., as may be required for the intended purpose.

1237 Binders

Binders to be used as primers or sealers shall be un-pigmented emulsions consisting of resin containing neither oil nor plasticizers. Binders are to be diluted with water in the proportions directed by manufacturers.

1238 Thinners

Turpentine and white spirit for thinning paints shall comply with the requirements of BS 245 respectively. Water for thinning shall be clean potable water. Thinners shall be applied in the proportions recommended by manufacturers.

124 EXECUTION

1241 General

Materials shall be prepared, mixed and applied in strict conformity with the manufacturer's instructions and as approved by the Engineer.

Materials shall be well stirred before application to produce a mixture of uniform density as required during the application.

No painting shall be carried out when rain, fog, condensation is likely to occur, the relative humidity exceeds 85% or the surface to receive paint or primers is damp.

1242 Surface Preparation & Paint Application

12421 General

All work on which painting is to be applied shall be inspected for satisfactory installation to enable painting to start.

Surfaces to receive paint shall be cleaned of all oil, grease, and loose and powdery material. Surfaces to receive paint shall be sufficiently dried before the application of the paint.

All removable items fixed on surfaces to receive paint, but not receiving paint shall be removed before application and re-installed after completion of work.

12422 Textured and rough surface

Mortar droppings and nips shall be removed and defects made good. Efflorescence shall be brushed off as it appears and all decoration deferred until it ceases. The application of paints shall be delayed until thorough or sufficient drying has taken place.

12423 Smooth masonry & concrete surface

The surface shall be washed down, where directed, with warm water and detergent, and allowed to dry. The quantity of water shall be kept to the minimum to ensure that wetting is on the surface only. Minor defects, cracks and holes, after cutting out as necessary, shall be made good as appropriate and rubbed down flush with the surrounding surface. Efflorescence shall be brushed off as it appears and all decoration deferred until it ceases. The application of paints shall be delayed until thorough drying has taken place.

12424 Wooden surfaces

All wooden surfaces shall be rubbed down smooth with fine abrasive, and dusted off. Sound knots, resinous streaks and bluish sapwood shall be given 2 coats of knotting which shall extend at least 25 mm around the affected area. Nails shall be punched well below the surface. After priming, defects such as open joints or nail holes shall be stopped with hard stopping, and surface imperfections faced up as necessary. All such repairs shall be primed before undercoating is applied.

Surface to be oiled shall be rubbed down to a smooth surface, filled as necessary, dusted off and oiled with a minimum of two coats of linseed oil or as approved by the Engineer applied with a flannel and well rubbing in. Filling shall be with an approved wood filler tinted to match the colour of the wood.

Surface to be varnished shall be rubbed down thoroughly and evenly with fine abrasive paper and filled as necessary. Filing shall be with approved wood filler, tinted to match the colour of the wood, rubbed down and dusted off. Varnish shall be applied in three coats, the first coat thinned with 25% of white spirit. When dry the first coat shall be lightly rubbed down with fine abrasive paper.

Surfaces to be treated with clear wood finish shall be rubbed down evenly with fine abrasive paper and filled as necessary. Filling shall be with approved wood filler tinted to match the colour of the wood, rubbed down and dusted off. Three coats of approved clear finish shall be applied, the first in the joiners shop where practicable, and two further coats immediately after fixing but before any deterioration of the first coat. The manufacturer's directions shall be adhered to in all respects including proportioning, mixing, temperature for application, and curing. Where directed, the finished work shall be matted down wet, rinsed, dried, and a high gloss produced with approved rubbing compound or matted to a satin finish.

12425 Iron & steel work

Bare iron and steelwork including sheeting and pipes shall be thoroughly prepared by removing all dirt, rust and loose mill scale to approval.

Painting shall be carried on after all hardware & iron mongeries are removed. Blasted surfaces shall be brushed or cleaned by vacuum.

They shall not be touched by hand or contaminated in any other way. Surfaces shall be protected within 4 hours of having been blast cleaned. Sample blast adequately protected by sealed clean polyethylene wrapping, shall be submitted for approval before any work is put in hand. The approved sample shall then be retained by the Engineer for comparison with the prepared steel work.

Mechanical cleaning shall be carried out by power driven tools, such as carborundum grinding discs, chipping hammers and needle guns, followed by steel-wire brushing and dusting to remove all loosened material. Excessive burnishing of the metal through prolonged application of rotary wire brush shall be avoided. Surfaces shall be protected within 4 hours of having been mechanically cleaned.

12426 New galvanized surfaces

New galvanized surfaces shall be thoroughly cleaned to remove all dirt, oil and grease and pre-treated with either an etching primer or approved etching compound.

12427 Painted surfaces

Painted surfaces shall be cleaned by removing old paints or cleaning the surfaces as specified. Removing, undercoats shall be applied evenly over the whole surface to give a solid film, care being taken to avoid uneven thickness of paint at edge and angles.

12428 Finishing Coat

Finishing coats shall be applied evenly over the whole surface to give a solid film free from brush marks, sags, runs, orange peeling or other defects.

12429 Plastic paints

Surfaces to receive plastic paint shall be rubbed down thoroughly and evenly with abrasive paper and filled as necessary. The filler shall be rubbed down and dusted off. Plastic paint shall be applied in one under coat and two finishing coats as approved by Engineer, with thinning and application time as recommended by the manufacturer.

Plastic paints shall be identified first for internal and external work and for matt and glossy finish.

124210 Oil paints

Surfaces to receive oil paint shall be rubbed down thoroughly and evenly with abrasive paper and filled with gypsum as necessary. The filler shall be rubbed down and dusted off. Oil paint shall be applied in one under coat and two finish coats or as approved by the Engineer, with the thinning and application time as recommended by the manufacturer.

124211 Synthetic enamel paint

Metal paints, after priming where necessary shall receive a minimum of two coats of synthetic enamel paint, or as approved by the Engineer. Thinning and application time shall be as recommended by the manufacturer.

1243 Cleaning

Clean all areas affected by painting, by washing, paint removal of affected areas and polishing surface to ensure that no paint marks are left on the affected areas.

125 METHODS OF MEASUREMENT

1251 General

Painting on different surfaces shall each be given separately.

Painting to internal and external surfaces shall be given separately.

The following shall be understood as included.

- Trimming cutting, matching patterns, and the like.
- Cleaning after decorating.
- Priming and background application to paints and other decorations.
- Working at any height and in different colours.
- Protecting the work from damage by other trades.

1252 Measurement

Painting, wall papers, plastic and fabric shall be measured by area.

Special application to edge shall be measured in length, by stating the girth of the surface exposed for painting.

Paints to metal surface shall be measured by area or the weight of the metal to be used.

1253 Classification

Painting and other decorative finishes shall be classified as follows: -

- Walls, columns and beams.
- Ceiling which shall include Soffits of beams,
- Slabs, staircases and in joinery.
- Floors.
- Staircases risers and treads.
- Skirting.
- Balustrades and rails.
- Doors, windows, curtain walls and partition.
- Metal surfaces.

13. GLAZING

131 DEFINITION

132 GENERAL REQUIREMENTS

1321 Work Included
Provide all necessary glazing, putty, beads, clips, fixing devices and labour required for the satisfactory performance of the work

1322 Related Works Described Elsewhere

Roofing	Section 06
Carpentry & Joinery	" 07
Metal works	" 10

1323 Quality Assurance

13231 Qualification of Workmen
Glass workers shall be skilled workmen thoroughly trained in handling, cutting and fixing glass. In addition to this requirement assign at least one person who is thoroughly familiar with the specific requirements and capable of guiding the trades men in the selection of material and execution of the works.

13232`Standard
Comply with the following Standards.
BS 952 Glass for glazing

1324 Protection
Protect glass and glazing during transport, storage, and before and after installation from breakage, scratch and other damage.

133 PRODUCTS

1331 General
Glass shall generally be free from bubbles, specks and other imperfection.

1332 Transparent glass

13321 Sheet glass
Transparent glass shall be clear, transmitting light and capable of distinctly showing objects through.

Transparent glass for ordinary purposes shall be clear, but may be coloured or tinted for special purposes.

The Quality of glass for general purposes shall be "Ordinary glazing Quality (O.Q). Selected glazing Quality (S.Q) and Special Selected Quality (S.S.Q) glass may be used for high grade work requiring fine & superfine work respectively.

13322 Figured glass
Figured glass shall have sufficient imprinting of texture or pattern to totally or substantially obscure vision and yet allow to transmit light. Figured glass for ordinary use shall be clear. Coloured or tinted may be used for special specified purposes.

The pattern or texture of figured glass shall be approved by the Engineer prior to use.

13323 Opal glass

Opal glass shall be white or colour opal on both faces as approved by the Engineer.

13324 Wired glass

Wired glass shall be Georgian or in normal hexagonal mesh. Wired glass shall be transparent, translucent or figured as may be specified in the schedule.

13325 Glass blocks

Glass blocks shall be translucent glass capable of carrying their own weight. Both surfaces of the blocks shall have normal pressed finish. The jointing faces shall be shaped or coated to ensure adequate bond between glass and concrete or mortar surfaces.

1333 Putty

Putty for glazing shall be quick hard setting tropical putty specially manufactured for glazing works.

1334 Polished plate glass for Mirror

Mirrors shall be produced in 6mm thick polished plate glass, silvered on one side. Silvering Quality (S.Q) shall depend on the standard of finish required. Mirror work shall be understood as including all related work including mirror, shelf or cabinet and fixing as indicated in schedule.

134 FIXING

Fixing rebates and grooves shall be clean, dry and un-obstructed at the time of sealing and glazing. Edge clearance shall be equal all round each pane, and not more than 2mm play all around and whether puttied or not, glass shall be beaded to frames.

External glazing shall be wind and watertight on completion.

Smears and excess compound and sealant shall be removed at completion. Both faces shall be cleaned with approved cleaner and the surface left free from scratches.

135 METHODS OF MEASUREMENT

Bedding, mastic and the like and fixing beads shall be understood to be included.
Cleaning before fixing glazing and at completion shall be understood to be included.
Unless otherwise stated glass shall be measured by the net cut area. Alternately glazing to louvers and special fixing may be enumerated or measured by length stating the size.
Panel of irregular shapes shall be measured as the smallest rectangle from which such irregular shapes can be cut.

Glass panes of special shape and decoration shall be enumerated.

Mirror shall be enumerated stating size.

No deduction shall be made to voids in glazing.

14. SANITARY INSTALLATION

141 GENERAL REQUIREMENT

1411 WORK INCLUDED: Provide all material, as indicated in the drawings and specified herein, labour, equipment, tools, temporary supports, and related items required for the satisfactory installation of sanitary works.

1412 RELATED WORKS DESCRIBED ELSEWHERE:
Earthwork (Section 02), Concrete (Section 03), Masonry (Section 04), Finishing (Section 11) and other related works described elsewhere in this specification shall be considered as equally applicable to this section in so far as the work is related.

1413 QUALITY ASSURANCE

14131 Standards
Comply with the following Standards and any of the Standards as may be referred to in this section.

Asbestos cement pipes	BS 486
Ductile iron pipes	BS 4772
Galvanized steel and pipe threads	BS 1387 & BS 21
Pre-cast concrete pipes	ESCD3.326
UPVC pipes for cold water services	BS 3505
UPVC pipes for foul and surface	BS 5481
Water drainage.	
Serialized coating on iron or steel	BS 4921
Vitreous China wash down W.C pans	BS 5503
Flanges and bolting for pipes, BS 4504	
Valves & fittings	
Joints and fittings for use with	BS 4346
UPVC pressure pipes	

14132 QUALIFICATION OF WORKMEN: Generally comply with the requirements of qualification of workmen in the General Requirements of this Specification.

In addition to these requirements assign at least one person who is thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of material and execution of the works of this section.

14133 SUBMITTALS: Submit manufacturers' test certificates, with the consignment or as directed for pipes and other plumbing and sanitary fixtures.

14134 PRODUCT DATA: Submit product data at a reasonable time prior to placement of order indicating the following: -

- List of all items proposed to be furnished and installed.
- Manufacturers name and place of manufacture.
- Catalogues, certificates, and other data demonstrating properties of materials, test results, methods of fixing and jointing.

1414 DELIVERY AND STORAGE

14141 PROTECTION: Use all means necessary to protect piping and other sanitary material during transport and before, during and after installation to ensure that no damage occurs to the materials, and coatings. In the event of damage to material or surface make all repairs or if unacceptable replace as required by the Engineer. Sanitary ware shall be supplied in their original packing.

14142 STORAGE: Pipes shall be stacked on level ground to ensure that no pipes rest on sockets or other joints. End of pipes in bottom rows shall be securely chocked to prevent collapse of stock. Pipes shall to the extent possible, be stacked in pyramid form and to a maximum height of 2000mm above ground.

Sanitary ware shall be stored in a locked room and in their original packing. No fixture shall be laid over the other unless there is proof that the packing material is capable of sustaining the load.

1415 PROTECTION AND STERILIZATION: Installed pipes shall be adequately protected against damage and deterioration. When handed over the installation shall be clean and in sound condition.

Water supply main and distribution pipes to be used for potable supplies shall be sterilized before using.

1416 TESTING

Water supply and drainage work shall be tested in section as directed by the Engineer after laying and jointing and before being covered up. The test shall be repeated after the pipes are covered up.

The length of pipes to be installed shall be such that they pass tests before and after being covered up. Valves and taps shall be broken down, lubricated and reassembled before final fixing.

Pipelines shall be cleaned before testing.

The water to be used for testing shall be clean potable water. The equipment and testing methods for pipe tests shall be subject to prior approval by the Engineer.

External water service pipes shall be subjected to a hydraulic test pressure of at least two times the working pressure at the lowest point of the pipeline section under test, maintained for a period of one hour.

Drainage pipe work shall be subjected to a hydraulic test pressure of 200mm head over the highest fitting level, maintained for a minimum period of 4 hours.

Internal water service pipe shall be subjected to an air test pressure of 10 Bar, maintained for a period of 15 minutes.

At the completion of testing defects in pipelines shall be made good and taps and valves checked for satisfactory flow and closing.

142 PRODUCTS

1421 PIPES

14211 **GALVANIZED STEEL PIPES**: Distribution pipe for potable water, internal and external installation shall generally comply with the requirements of BS 1387, medium gauge, having plain or threaded ends to BS 21.

Galvanized steel pipefittings shall comply with BS 21.

14212 Ductile iron pipe for external distribution shall comply with the requirements of BS 4772 with flexible spigot and socket connections.

14213 UPVC pipes and solvent weld spigot and socket fittings for cold water shall comply with the requirements of BS 3505 and BS 4346, part 2 respectively.

14214 UPVC pipes and fitting for solvent cement weld for found surface drainage shall comply with the requirement of BS 5481.

14215 Precast concrete pipes for foul and surface drainage shall comply with the requirements of ESC D3. 326 and shall be cement jointed.

14216 Steel components, bolts and nuts shall be zinc coated complying with the requirements of BS 4921. Steel flanges shall comply with the requirements of BS 4504.

1422 SANITARY FIXTURES

14221 General

142211 Sanitary fixtures shall comply with the minimum standard as set out in this section. Sanitary Fixtures shall be manufactured to standards acceptable for the intended purpose. Fixtures and accessories shall always be obtained from one source to the extent possible. Appliances shall be supplied together with mounting and plugging devices, valves, chain, waste plug, traps, handles, flexible pipes, with accessories such as bolts, nuts, screws, hinges, fishers etc., as required for the satisfactory installation. The following shall be the minimum standards of sanitary ware to be installed unless altered in the Bill or Schedule of Sanitary Ware.

14222 W.C Units

142221 Ideal standard, white vitreous China W.C unit to BS 5503, 1977 close coupled or low level flush, with manufacturer supplied or recommended flush apparatus, cistern, plastic seat & cover, inlet and drain connector, trap and complete with fixing devices.

142222 Ideal standard, white vitreous China W.C unit to BS 5503, 1977, high level flush cistern, plastic seat and cover, inlet and drain connector, trap and complete with fixing devices.

142223 Ideal standard, enameled white cast iron pedestal pan W.C unit, concealed flush & cistern, plastic seat and cover inlet and drain connector, trap and complete with fixing devices.

142224 Ideal standard, white enameled cast iron, squatting pan W.C. unit, high level flush cistern, inlet and drain connector, trap and complete with fixing devices.

142225 Precast Terrazzo squatting pan W.C unit, high level Flush cistern, inlet and drain connector, trap and Complete with fixing devices.

14223 Wash Hand Basins

142231 White Vitreous China, standard white wash hand basin of specified size, with a pair of white painted cast iron screw to wall brackets, 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold water valve only.

142232 White Vitreous China, standard white wash hand basin of specified size, with a pair of white painted cast iron screw to wall brackets, 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold & hot water valves.

142233 White Vitreous China, standard white wash hand basin of specified size, with a pair of white painted cast iron screw to wall brackets, 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold & hot water valves and mixer.

142234 White Vitreous China, standard white wash hand basin of specified size, standard white pedestal with 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold water valve only.

142235 White Vitreous China, standard white wash hand basin of specified size, standard white pedestal with, 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold & hot water valves.

142236 White Vitreous China, standard white wash hand basin of specified size, standard white pedestal with 32mm slotted basin waste and over flow, chromium plated basin chain and rubber plug, 32mm chromium plated or PVC bottle trap and connector, flexible pipe connectors, complete with fixing devices and chromium plated cold & hot water valves and mixer.

14224 Urinals

142241 White vitreous China Urinal Bowl, supported on concealed wall hangers, 9 liter capacity, high level cistern with automatic siphon, flexible pipe connector, drip tap, stainless steel exposed flush pipes, 38mm waste strainer and bottle trap.

142242 Two unit with division, white vitreous China urinal bowl, supported on concealed wall hangers, 9 liter capacity high level cistern with automatic siphon, flexible pipe connector, drip tap, stainless steel exposed flush pipes, 38mm waste strainer, bottle trap and spreader.

14225 Bath Tub

142251 Standard white, enameled steel bathtub 1700x700mm with flexible tube hand spray shower & wall brackets no tap holes, twin grip, 38mm combined waste and over flow, shallow seal bath trap and wall mounted bath mixer.

142252 Standard white, enameled steel bathtub 1700x700mm with pillar tap shower spray, no tap holes, twin grip, and 38mm combined waste and over flow, shallow seal bath trap and wall mounted bath mixer.

142253 Standard white, enameled cast iron bath tub 1700x700mm with flexible tube hand spray, shower & wall brackets, no tap holes, twin grip, 38mm combined waste and over flow, shallow seal bath trap and wall mounted bath mixer.

142254 Standard white, enameled cast iron bathtub, 1700x700mm with pillar tap shower spray, no tap holes, twin grip, and 38mm combined waste and over flow, shallow seal bath trap and wall mounted bath mixer.

142255 Standard white, reinforced acrylic bath tub 700x700mm with flexible tube hand spray shower & wall brackets, no tap holes, twin grip, 38mm combined waste and over flow, shallow seal bath trap and wall mounted batch mixer.

142256 Standard white, reinforced acrylic bath tub 1700x700mm with pillar tap shower spray, no tap holes, twin grip, 38mm combined waste and over flow, shallow seal bath trap and wall mounted bath mixer.

14226 Water Heater

Specified capacity wall mounted, standard white water heater with minimum 50mm thick polyurethane insulation, stainless steel sheathed element, precision thermostat, and twin inlet flexible pipe connectors.

14227 Shower Units

142271 Shower Trays, of specified size in white enameled steel, with 38mm grated waste outlet and shallow seal bath trap. (Fittings measured separate)

142272 Shower Trays, of specified size, in precast terrazzo with 38mm grated waste outlet and shallow seal bath trap. (Fittings measured separate)

142273 Shower Trays formed by recessing floor 200mm minimum or as detailed in drawing below normal floor finish and built in the same material as floor or lined as shown in drawing, with 38mm grated waste outlet and shallow seal bath. (Supply fittings measured separate)

142274 Shower Fittings - Cold water supply brass valve and fixed showerhead.

142275 Shower Fittings - Cold water supply chromium plated valve, fixed head and arm.

142276 Shower Fitting - Cold water supply chromium plated valve, adjustable head and arm.

142277 Shower Fittings - Cold water supply chromium plated exposed riser, valve and adjustable head and arm.

142278 Shower Fittings - Cold and hot water supply chromium plated exposed riser, mixer, valve and adjustable head and arm.

14228 Sinks

142281 1000x500mm single bowls, single drain, steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold water supply. The sink shall be fixed to wall using white painted cast iron brackets if no mounted on counter.

142282 1200x500mm single bowls, single drain, steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142283 1500x500mm double bowl, single bowl, single drain, steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142284 1800x500mm double bowl, double drain, steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142285 1000x500mm single bowl, single drain, stainless steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold and hot water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142286 1200x500mm single bowl, single drain, stainless steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold and hot water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142287 1500x500mm double bowl, single bowl, single drain, stainless steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold and hot water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142288 1800x500mm double bowl, double drain, stainless steel sink with combined waste and over flow 38mm bottle trap, wall mounted chromium plated valve and over arm spout for cold and hot water supply. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

142289 Specified size, white glazed plain edge fire clay sinks, with combined waste and over flow, 38mm bottle trap, wall mounted cold water supply chromium plated valve, over arm spout. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

1422810 Specified size, white glazed plain edge fire clay sinks, with combined waste and over flow, 38mm bottle trap, wall mounted cold and hot water supply chromium plated valves, over arm spout. The sink shall be fixed to wall using white painted cast iron brackets if not mounted on counter.

14229 Other Accessories

142291 Toilet roll, chromium plated surface mounted screwed to wall, spring roller.

142292 Toilet roll, screwed to wall white vitreous China for recessed or surface installation.

142293 Soap dish, chromium plated for surface installation screwed to wall.

142294 Soap dish, white vitreous China for recessed or surface installation screwed to wall.

142295 Specified length towel rail 20mm diameter chromium plated, concealed both and fixed in concealed brackets.

142296 Towel hooks/rings, chromium plated and screwed wall.

142297 Shower curtain track in 25mm thick chromium plated, eight guilders/meter, end stop and both ends concealed fixing brackets.

142298 Shower curtain, plain pattern, Nylon white/coloured and 800mm high.

142299 Specified diameter, enameled steel grated floor drain with shallow seal trap.

1422910 Precast concrete trough in C-25 concrete, reinforced and exposed surfaces finished as shown in drawing with 50mm trapped drain and 15mm brass bib tap.

1422911 Precast terrazzo Janitor's sink with a pair of white-coated metal screwed to wall brackets, 32mm slotted basin waste, 38mm bottle trap and wall mounted 15mm brass tap.

143 INSTALLATION

1431 SETTING OUT: Services and drains shall be set out in accordance with the drawings and instructions by the Engineer. Temporary benchmark shall be maintained for as long as necessary.

1432 TRENCH EXCAVATION & CUTTING: Excavation for pipe laying shall be carried out only after a full supply of pipes has been made readily available for that section. The bottoms of excavations shall be trimmed and consolidated to the correct levels. Any excavation in excess of the required depth shall be material of the same composition as pipe beds. If the bottom of excavations is not firm, excavation shall be carried to firm level and to approval by the Engineer and filled with material of the same composition as pipe bed.

Rock projections, boulders and any hard spots shall be removed and excavations made to true level.

The minimum width of excavations for pipes shall be 600mm for pipes up to 200mm diameter and not less than 600mm greater than the external diameter of the pipe for pipe sizes over 200mm.

The bottom of excavations shall be approved prior to bedding.

1433 PIPE LYING

14331 **INSPECTION** - Pipes and fittings shall be inspected for damages and defects prior to laying. Any pipes found to be damaged or defective shall be rejected and removed off the site if determined unsuitable for any purpose.

14332 LAYING - Pipes shall be carefully lowered into trenches and layd truly straight on line and gradient. The sockets of pipes shall be maintained upstream. Pipes shall be laid single on bed. A straight level laid on the invert of the pipe shall check the level. The level shall be checked against the invert of the pipe previously laid and the nearest level peg. Pipes shall not be laid on their collars or on temporary supports.

14333 JOINING OF PIPES - Pipes shall be joined in accordance with the appropriate practice for each type of pipe and strictly following the

manufacturers' instructions. Solvent cement to be used for UPVC, PVC, Polyethylene pipe and fitting jointing shall be as recommended by the pipe and fitting manufacturer.

14335 FIXING OF SANITARY WARE

Sanitary ware shall be fastened, screwed or fixed in strict conformity with the manufacturers recommendations for the materials and methods of fixing.

1434 PIPE COVERS AND SUPPORTS

14341 CONCRETE BEDS AND SURROUNDS

Concrete beds and surround shall be in C-15 plain concrete minimum 50mm below pipe, 150mm wider than the diameter of the pipe and 150mm thick above crown of pipe or as detailed on drawings. Concrete surrounds to internal installation shall be in the quality and thickness of concrete use for the structure. Where pipes are buried in walls cement sand mortar mix 1:3 shall be used to cover up the pipes.

14342 GRANULAR BEDS AND SURROUND

Granular beds and surround shall be graded gravel approved by the Engineer with a maximum size of 20mm free from dust and organic material. The bed shall be placed to the width of the trench, 50mm below pipe and up to 150mm above the crown of pipe or as indicated in drawings.

14343 BACKFILL TO PIPE EXCAVATION FOR SERVICE PIPES

Where granular fill is not used, pipe surrounds and the fill 300mm above the pipe shall be in selected excavated material free from stones retained on 20mm sieve. The backfill above granular or selected excavated material fill and concrete surrounds shall be in excavated materials in layers not exceeding 200mm before compaction. No mechanical compactors shall be used before there is 1000mm of fill material on the pipes or there is 600mm of fill material if the pipe has concrete surrounding.

14344 Thrust blocks at branches and changes of directions where shown, shall be in C-15 concrete sizes as shown on drawings.

14345 Where pipes in buildings run exposed, supports and anchors shall be provided as detailed in drawings, ensuring that adequate precaution is taken to allow sufficient freedom for movement of pipes due to thermal variation.

1435 MANHOLES & CATCH PITS

Manholes shall be in precast concrete C-20 quality, brick or Class a hollow block work as indicated and detailed in the drawings. The manholes shall be laid on a minimum concrete bed of 150mm, C-20 concrete.

Manholes other than precast concrete shall be plastered internally and externally where there is no underground infiltration with two coats of cement plaster. Joints of precast concrete manhole shall be flush pointed.

The base of manholes shall be benched using half pipes or C-20 concrete to form smooth transition between inlet and outlet. Benched and other surfaces shall be smoothened in cement screwed.

Manhole covers shall be in cast iron cover and frames or C-25 precast concrete as detailed in drawings.
Manholes shall be enumerated stating the size and shall be deemed to include related earth and other works for the completion of the work.

1436 SEPTIC TANKS, SOAK PITS & PERCOLATION FIELD

The relevant sections of the Technical Specification shall be applied to the construction of the above. The measurement shall be done in accordance with the stated method of measurement for each item in the works.

1437 VALVES

Flanges check valves, gate valves, service valves, etc., shall be in the specified material and size and installed at the positions indicated on the drawings or as directed. The installation shall include pipefittings for the easy removal and assembly of the valves for maintenance.

144 METHODS OF MEASUREMENTS

1441 GENERAL

Installation shall be classified by function and given under appropriate headings.
Installation shall be measured in accordance with the relevant clause under this section and applicable clauses in the other sections of these methods of measurement.

Unless otherwise stated the following are understood as included.

- Incidental work, including but not limited to other trades, cutting, forming, holes, mortises, chases, making good finishes, bedding in, cutting and pinning of brackets and the like.
- Protecting the work from damage by other trades and protective paint to exposed parts.
- Testing.
- All earthworks in connection with plumbing work.
- Pipe supports, fittings, flexible pipes, faucets to installation and the like.
- Fittings other than valves.

1442 MEASUREMENT

Pipes shall be measured by length taken along the centerline and over all fittings.

Valves shall be enumerated.

Fixtures shall be enumerated and shall be understood as including all accessories valves, connection, control devices and supports for the satisfactory operation of the fixture.

Duct Work shall be measured by length stating the girth.

Connections to supply main shall be enumerated.

Insulation to supply lines shall be measured by length specifying pipe diameter and along the centerline of the pipe.
Catch pits and manholes shall be enumerated stating the size and shall be understood as including all earth, concrete and surface finish works. Connection of pipes to manholes and catch pits shall be understood as included.

15. ELECTRICAL INSTALLATION

151 GENERAL REQUIREMENT

1511 SCOPE OF WORK

This work includes the supply, erection, and installation, testing, commissioning and putting to work of the complete L.V. supply network, all electrical installations, services and street lights as shown generally in the drawings and described in this Specification.

1512 QUALIFICATIONS OF WORKMEN

Generally comply with the requirements of qualification of workmen in the General Requirements Section of this Specification.

In addition to these requirements assign at least one person who is licensed and thoroughly familiar with the specified requirements and capable of guiding the tradesmen in the selection of material and execution of the works of this Section.

1513 STANDARDS

Where Standards to which equipment or materials must comply are cited, the Engineer accepts goods meeting other authoritative standards subject to approval. Where materials, appliances or fittings, patented or otherwise, are prescribed, or the names of manufacturers or agents are given, it is to be clearly understood that such reference is used only for the guidance of the Contractor with respect to the nature and quality of the articles or services required. Offers of alternative equipment, articles or material may be accepted but all materials shall be of equal quality and workmanship to that prescribed and shall be subject to approval by the Engineer.

At the time of tender, the burden of proof that, equipment offered is of equal standard to that specified shall be on the Contractor. In offering such material or equipment, the Contractor shall include with his tender, the detailed information necessary to demonstrate quality.

The presentation of such data shall take the form of comparison sheet giving in one column the critical parameters required by the relevant quoted Standard and/or equipment specified, and an adjacent column giving the standards of the equipment offered in the tender.

1514 REGULATIONS

All work carried out by the Contractor shall comply with the following Regulations: -

The latest edition of the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers, Savoy Place, London WC2 and any special regulations or requirements of the Ethiopian Electric light and Power Authority.

1515 TEST CERTIFICATES

The Contractor shall be deemed to have examined test certificates for all plant, equipment and materials provided under this Contract and to have satisfied himself that all component parts of the Works are tested as suitable for erection and installation in the areas required for the works.

Copies of such certificates shall be presented to the Engineer as evidence.

1516 TESTING OF COMPLETED INSTALLATION

Site testing of the general electrical installation shall be carried out on completion of the works, on completion of sections of the works, or at any time as requested by the Engineer. This test shall be witnessed and three copies of Test Certificates giving the results of the tests shall be submitted.

The following tests shall be carried out in accordance with the requirements of EELPA.

- Insulation resistance tests between phases and each phase to earth.
- Earth continuity tests on all circuits.
- Earth resistance of earth electrodes.
- Line and neutral earth loop impedances from selected positions on site.

1517 "AS BUILT" RECORD DRAWINGS

A complete and detailed layout drawing together with the specification of materials used for the works shall be submitted at the completion of works.

152 MATERIALS & EXECUTION

1521 GENERAL

Materials used in the works shall be new, the best of their respective kinds, and obtained from manufacturers approved by the Engineer.

Materials shall be fully in accordance with qualities, tolerances, tests, recommendations, methods of workmanship and requirements as described or named in the relevant British Standard Specification, the International Electro technical Commissions (IEC) publications, or in conformity with the latest edition of EELPA specifications.

The Contractor, when and if required, shall supply samples where or prototypes of all materials or workmanship before work is put in hand. The samples shall be retained until the main bulk of materials are delivered to site.
Samples will be required only where the Engineer would find it difficult to verify standards and quality from drawings and descriptions supplied by the Contractor.

MOUNTING HEIGHTS

Except where otherwise detailed in the drawings or stated in the Bill of Quantities all accessories and fittings shall be fixed at the following heights above finished floor level: -

- Distribution boards 1700mm to centerline of board
- Lighting switches and push buttons 1400mm.
- Lighting switches and push buttons above beds 1000mm.
- Sockets (general) 300mm.
- Sockets on or above benches 1500mm above bench top
- Sockets in Workshops 1100mm.
- Telephone outlets 300mm.
- Bells 2100mm

1522 UNDERGROUND CABLE DUCTS

15221 General

Underground cable ducts for incoming power supply cables and telephone service cables to the buildings, shall be supplied and installed by the Contractor. It shall be the responsibility of the Contractor to ensure that the underground duct is installed correctly according to each party's requirements; and to the purpose. The Contractor shall liaise closely with EELPA and ETA to ensure that their requirements fully satisfied. It shall be the Contractor's responsibility to ensure that adequate information concerning easy bends, directions of runs, etc. is given before work commences.

15222 Precast Concrete Pipes

Precast concrete pipes for cable drawing shall comply with the requirements of ES C D3. 326.

The pipes shall be jointed in cement sand mortar mix 1:3.

Precast cement pipes shall be measured in length and shall be understood as including fitting and related earth and concrete work.

15223 Galvanized Steel Pipes

Galvanized steel pipes for cable drawing shall generally comply with the requirement of BS 1387, light gauge having threaded ends to BS 21.

The pipe laying shall fully comply with the requirements as set out in the Sanitary Installation section of this Specification.

Galvanized steel pipe laid for cable drawing shall be measured in length and understood as including all earth, masonry and concrete work.

15224 PVC Pipes

PVC drainpipes for cable drawing shall generally comply with the requirement of BS 5481.

The pipe laying shall fully comply with the requirements as set out for UPVC drainage pipes in the Sanitary Installation section of this Specification.

PVC pipe laid for cable drawing shall be measured in length and understood as including all earth, masonry and concrete work.

15225 Manholes

Manholes shall be in precast concrete C-20 quality, brick or Class a hollow block work as indicated and detailed in the drawings. The manholes shall be laid on a minimum concrete bed of 150mm, C-20 concrete. Manholes other than precast concrete shall be rendered internal and externally with two coats of cement mortar. Joints of precast concrete manholes shall be flush pointed.

Manholes covers shall be in cast iron cover and frames or C-25 precast concrete as detailed in drawings.

Manholes shall be enumerated stating size and shall be deemed to include related earth and other works for the completion of the work.

15226 Conduits for Internal Wire Drawing

All metal conduits shall be heavy duty galvanized and shall be laid in straight and symmetrical lines. The ends of all conduits shall be carefully reamed to remove all burrs and sharp edges after the screw threads have been cut. The ends of the conduits shall be butt welded solidly in all couplings, and where conduits terminate in switch fuses, fuse boards, adaptable boxes etc., they shall be connected thereto by means of smooth bore male brass brushes, compression washers and sockets. All bends shall be made on site to suit site conditions and not more than two right angle bends shall be permitted without the interposition of a draw box. No tees, elbows or bends either solid or inspection will be permitted, unless specifically mentioned in the specification or in the drawings.

All PVC conduits shall be of high impact PVC type. Ends shall be carefully trimmed of all burrs. Joints shall be made using adhesive supplied by the conduit manufacturer.

1523 DISTRIBUTION BOARDS

15231 Cubicle Panel Boards

The Contractor shall supply and install medium voltage main distribution panels in as indicated in the drawing. The main distribution panel shall be of the cubicle panel type. The Contractor shall submit detailed drawings of the proposed panel layout for approval of the Engineer.

The design and arrangement of the panel shall be such as to permit the ready addition or replacement of incoming and outgoing cables. There shall also be ready access to any component requiring maintenance including all bolted or clamped connection.

15232 Main and Sub Distribution Boards

The Contractor shall supply and install distribution boards in the positions indicated on the drawings. All sub-main distribution boards shall be complete with isolator or fused switch as applicable.

The distribution boards shall be complete with all necessary earth bonding gland-plates, cable entries, fixing brackets and supports for the cables specified and the locations indicated.

Sub-distribution boards shall be surface/flush mounted as specified in the Bill.

Distribution boards shall be of the type fully enclosed sheet steel cabinets and hinged cover. Each shall be a one standard panel section having the number of pitch units as detailed in the drawings. Boards shall consist of approved single and triple pole miniature circuit breakers. The current rating and type of each panel are indicated on the appropriate distribution boards diagram.

Unused reserve pitch units shall be fitted with molded plastic cover strips. Full facilities shall be provided within the panel for the fitting of future additional circuit breakers. The circuits fed from the distribution board shall be marked on a card fixed to the inside of the lid. This card must indicate without ambiguity the location of all the outlets fed from each distribution way, and the size of the fuse of circuit breaker rating. The information must either be typed or printed on the card, or presented in similar legible manners.

Distribution and sub-distribution boards, bus bar rating, type of mounting (surface, flush), etc. shall be indicated in the drawing. The reference number of the Board shall be used in the Bill.

Distribution boards shall be enumerated and understood as including all related works.

15233 Terminal covers shall be of molded plastic; surfaces mounted with bare plate, 35mm wide rail and wire entry knockouts. Terminal covers shall include all related work. Terminal covers shall be enumerated with reference to the number in the drawing.

1524 PVC CABLES

Underground cables shall be PVC insulated, PVC bedded, steel wire unarmoured/armoured and PVC served overall. Unless, specifically indicated otherwise, all cables shall have copper conductors.

PVC sheathed and insulated power cables shall generally be of the type Siemens NYY 0.6/1KV or equivalent.

PVC cable shall be measured in length and understood as including all related work.

1525 light, POWER AND SOCKET OUTLETS

15251 General

Unless indicated on drawings or schedules the following shall be the minimum standard of light, power, switch and other outlets & fittings. Outlets shall be enumerated and understood as including all related work.

15252 Light Points

152521 Light points fed through specified size PVC insulated conductors of type Siemens NYM or equivalent, in thermoplastic conduits of 13.5mm diameter for recessed installation, including junction boxes with cover & insulating caps.

152522 Light points fed through specified size PVC insulated conductors of type Siemens NYM or equivalent, in rigid thermoplastic conduits of 13.5mm diameter for surface installation, including junction boxes with cover & insulating caps.

152523 Light points fed through specified size PVC insulated conductors of type Siemens NYM or equivalent, in steel conduits of 15mm diameter for surface installation, including junction boxes with cover & insulating caps.

152524 Switch point of specified pole & type carried through PVC insulated conductors of type Siemens NYM or equivalent, in thermoplastic conduits of 13.5mm diameter for recessed installation including junction boxes with cover and insulating caps.

152525 Switch point of specified pole & type carried through PVC insulated conductors of type Siemens NYM or equivalent, in rigid

thermoplastic conduits of 13.5mm diameter for surface installation including junction boxes with cover and insulating caps.

152526 Switch point of specified pole & type carried through PVC insulated conductors of type Siemens NYM or equivalent, in steel conduits of 15mm diameter for surface installation including junction boxes with cover and insulating caps.

15253 Socket Outlets

152531 General
All socket outlets shall generally be "Siemens SCHUKO" type or similar approved by the Engineer.

152532 Socket points of specified rating fed through PVC insulated conductors as shown in drawing inside thermoplastic conduits of diameter as shown in drawing for recessed installation including junction box with covers and insulating caps.

152533 Socket points of specified rating fed through PVC insulated conductors as shown in drawing inside rigid thermoplastic conduits of diameter as shown in drawing for surface installation including junction box with covers and insulating caps.

152534 Socket points of specified rating fed through PVC insulated conductors as shown in drawing inside steel conduits of diameter as shown in drawing for surface installation including junction box with covers and insulating caps.

15254 Bell Points

152541 Bell points fed through PVC insulated conductor of 2x0.8mm2 inside thermoplastic conduits of 13.5mm diameter for recessed installation including junction boxes with covers and insulating caps.

152542 Bell points fed through PVC insulated conductor of 2x0.8mm2 inside rigid thermoplastic conduits of 13.5mm diameter for surface installation including junction boxes with covers and insulating caps.

152543 Bell points fed through PVC insulated conductor of 2x0.8mm2 inside steel conduits of 15mm for surface installation including junction boxes with covers and insulating caps.

15255 Fan Outlets

152551 Fan outlets and switch points fed through PVC specified size insulated conductors inside thermoplastic conduits of 13.5-16mm diameter for recessed installation including junction boxes with cover and insulating caps.

152552 Fan outlets and switch points fed through PVC specified size insulated conductors inside rigid thermoplastic conduits of 13.5-16mm diameter for surface installation including junction boxes with cover and insulating caps.

152553 Fan outlets and switch points fed through PVC specified size insulated conductors inside steel conduits of 15mm diameter for surface installation including junction boxes with cover and insulating caps.

15256 Power Outlets

152561 Power outlets of specified rating PVC sheathed cable, specified size of thermoplastic conduit for recessed installation, including junction boxes with cover and insulating cap.

152562 Power outlets of specified rating PVC sheathed cable, specified size of rigid thermoplastic conduit for surface installation, including junction boxes with cover and insulating cap.

152563 Power outlets of specified rating PVC sheathed cable, specified size of steel conduit for surface installation, including junction boxes with cover and insulating cap.

15257 Telephone Outlets

Conduits for telephone system shall be installed complete as indicated in drawings.

The wiring for each telephone outlet shall be carried out by the Ethiopian Telecommunication Authority. The Contractor shall liaise with ETA to verify that adequate concealed conduits have been included.

Telephone conduits shall be thermoplastic conduit for recessed installation.

15258 Television Antenna Outlet

152581 Television Antenna outlets with flat twin T.V cable inside thermoplastic conduits of 20mm diameter for recessed installation including junction boxes with cover and insulating caps.

152582 Television Antenna outlets with flat twin T.V cable inside rigid thermoplastic conduits of 20mm diameter for flush installation including junction boxes with cover and insulating caps.

152583 Television Antenna outlets with flat twin T.V cable inside rigid steel conduits of 20mm diameter for flush installation including junction boxes with cover and insulating caps.

1526 FIXTURES

15261 Bell System

152611 Bell system with buzzer and call indicator panel of specified number for flush installation, including bell transformer 220/8V.

152612 Bell system with buzzer and call indicator panel of specified number for surface installation, including bell transformer 220/8V.

15262 Fans

Ceiling or wall mounted fans of type specified in Bill or equivalent with speed regulator switch.

15263 Air Conditioners

Air conditioner units of specified types & rating including all related work and commissioning.

15264 Light Fixtures

Light fittings and fixtures shall be approved type and be installed as indicated on the drawings and the Bill.

Tungsten filament lamps shall be of the general service type and coiled coil pattern in applicable sizes. Where lamps are visible under normal viewing conditions, they shall be of the Argenta K (pearl) lamp type.

All fluorescent lamps shall be of the bright white colour, temperature around 4000 K (Philips TL/33) or equal, which combines well with daylight.

The reference number for light fittings as indicated on the drawings and schedules shall be strictly adhered to.

1527 SUNDRY ITEMS

15271 Poles

152711 Impregnated wooden poles of specified height, and diameter 165-175mm for L.V distribution and street lighting system shall be impregnated wooden poles complying with the requirements of EELPA. The wooden poles shall be securely embedded in earth with C-15 concrete as detailed in drawing. The minimum depth of holes shall be 1200mm for normal soil & 800mm for rock area.

152712 Galvanized or mild steel finished painted, aluminum and pre-painted circular steel pipes for street lighting shall be constructed and erected in accordance with the detail drawings. C-25 concrete shall be used for anchoring the poles.

15272 Pole Accessories

152721 Insulators

Porcelain insulators (Pin Type Insulators) type N80 and N95 with arrangement for pin and hook tips to be fixed with plaster of Paris shall be used. N80 is to be used for small size conductors and N95 with conductors larger than 25sq.mm. Porcelain glazed insulators (Shackle Insulators) Type Y-9732 with shaft hole diameter of about 18-25mm with major lobes about 60-100mm in diameter are to be used at dead end; at T-junction and at bent poles.

Hot drip galvanized steel sawn rock hooks are to be screwed into wooden poles for insulations of N80 and N95.

Hot drip galvanized pins shall be used with steel cross arms for insulators N80 and N95.

Guy or stay insulators of glazed porcelain are to be used to break the continuity of galvanized steel wires used for guying. Guy insulators are to be placed at heights of about 3-5m above the ground depending on the length of the pole used.

For shackle insulators D-iron with bolt and nut constitutes the hardware part. The D-iron is a rectangular hot dip galvanized steel at least 38x6mm in cross-section. The assembly is used for dead-ending low tension line.

152722 Cross arms of types specified in the Bill as per EELPA specification shall be produced from various sizes of steel channels. Cross arms shall include fixing collars, bolts and nuts with holes for insulator pins.

152723 Aerial fuses with porcelain type fuse holder and section switch with rating as specified in the Bill shall be mounted on poles.

15273 Conductors

152731 Bare copper conductors of sizes specified in Bill for overhead conductors shall be in accordance with EELPA requirements.

Bare copper conductors' shall be measured in length stating size.

152732 PVC insulated conductors shall be PVC insulated copper conductor of the type Siemens NYM or similar.

PVC insulated conductors shall be measured in length stating size.

15274 Photo-electric Cell

Photoelectric cell complete with light sensitive switch of rated capacity for light fixture including rated capacity automatic circuit breaker for electrical protection of the switch shall be used. Care shall be taken to ensure that the photocell shall not be located facing the street lighting lamps to be controlled by the light sensitive switch.

Photoelectric cell shall be enumerated.

15275 Earthing

The installation of the earthing system shall be in accordance with Section D of EELPA regulation. The Sub-Contractor shall supply, install and connect all necessary conductors, clamps, connectors, terminals etc. for an efficient earthing system.

The entire electrical installation together with the armoring or metallic sheathing of all cable shall be electrically continuous throughout forming a completely bonded earth system.

The Contractor shall ensure that every complete earth loop circuit comprising conduits, cable sheaths, core conductors etc. shall have an impedance value not exceeding that laid down in the latest edition of EELPA Regulations.

15276 Lightning Protection System

The Contractor shall supply and install lightning protection system complying with EELPA regulations for the protection of structures against lightning.

15277 Generator System

The details of the generator to be supplied shall be given either in the schedule or annex to the Technical Specification.

Generator shall be enumerated.

153 MEASUREMENTS

GENERAL

Installation shall be classified by function and given under appropriate headings.

Installation shall be measured in accordance with the relevant clause under this section and applicable clauses in the other sections of this method of measurement.

Incidental work, including but not limited to other trades like, cutting, forming holes, mortises, chases, making good finishes, bedding in, cutting and pinning in of brackets and the like shall be understood to be included.

Protecting the work from damage by other trades is understood to be included.

Testing and commissioning is understood to be included. Unless measured separate all earthwork in connection with electrical installation is understood to be included.

Accessories necessary to complete an installation are understood to be included.

16. EXTERNAL WORKS & SERVICES

161 GENERAL REQUIREMENT

The detailed requirements as specified in other sections of this Technical Specification are equally applicable to the works under this section whether or not mentioned.

162 FENCING

1621 Work Included

Provide all concrete, masonry, timber, steel, metals and other material and labour required for a complete and satisfactory installation of fencing works.

1622 Standards

Comply with the requirements of the standards referred to in concrete, masonry, structural steel, metal work and carpentry and joinery in as far as they are applicable to the work under consideration.

1623 Fencing Classification

16231 General

Fencing shall be built-in stone, brick, block masonry and in-situ or precast concrete, metal, steel profiles, timber or combinations of any of the materials.

The methods of measurement to be followed shall be as specified in each applicable section of this Technical Specification.

16232 Fence posts

Concrete posts shall be built in precast concrete of quality and detail, with size, shape, reinforcement, cranking, etc., as shown in drawings.

Steel posts shall be built-in mild black steel or galvanized steel profiles of types sizes and cranking as detailed on drawings. Mild steel black posts shall be primed and anti-rust paint coated.

Timber posts shall be in round or other shape pressure impregnated timber as shown on drawings.

Single or Double strainer posts shall be built-in the same material and profile to the extents possible.

Single or Double strainer posts shall be securely welded, nailed or tied to up right posts as shown on drawings.

Posts shall be securely embedded in post holes with concrete, stone chipping or gravel as shown in drawings. The depth to be embedded shall be as shown in drawings. The minimum depth shall be 500mm. If embedded in concrete, the concrete shall be class C-15 and extending at least 100mm below the bottom of the post.

Holes shall be drilled in steel posts at tie points. Anchor hooks of galvanized wire of not less than 2.5 mm in thickness shall be nailed to timber posts and embedded in concrete posts for tie wires.

Strainer posts to uprights shall be provided at corners, ends, changes of direction and at distances not exceeding 70 meter in straight run.

Fence posts shall be enumerated specifying post type height and size and understood as including all related work.

16233 Wire Fences

Wire fences shall be built-in galvanized steel wire mesh (chain link), plain wires, & barbed wires as detailed on drawings.

The thickness of materials, the mesh spacing and the number of barbed and line wires shall be as shown on drawings.

Galvanized wires for fencing shall not be less than 2mm thickness.

Strainer & tie wires in mesh fencing shall always be provided at the top and bottom of the wire mesh at the minimum.

Fences shall be securely strained and tied to posts in galvanized steel of not less than 1.5mm thickness.

Wire fencing shall be measured in length stating height and shall be understood as including all material and work as shown on drawings.

163 PAVING

1631 General Requirement

The Specifications in the earthwork, masonry & concrete sections of this Technical Specification shall be equally applicable to works under this section in as long as the work is related.

1632 Excavation, Fill, Disposal & Trimming of Slopes

Comply with the requirement of the Specification in the Earth Work Section of this Technical Specification for excavation, fill, disposal and trimming of slopes under external paving.

1633 Sub-Base

Hard-core sub-base shall be in basalt or other sound stone approved by the Engineer, having a finished uniform thickness of 200mm, finished compacted to the approval of the Engineer.

Materials forming direct support of pavement shall be hard durable stone chips, gravel or other selected fill material, well graded to the required sizes.

The material shall be free from vegetable matter & clay lumps.

Naturally occurring sub-base material shall be scarified, watered, uniformly mixed and compacted to at least 95% MDD. Where improved sub-base is to be placed, the upper 150mm of soil under the improved sub-base shall be compacted to 95% MDD.

The improved sub-base shall be placed on the sub-soil, watered & compacted at 200mm thickness to a dry density of 95% MDD. Sub-grade shall be cleaned off all foreign material.

Potholes, loose material, corrugations, depressions and other defects appearing on sub-base shall be corrected to the satisfaction of the Engineer.

The final surface of sub-base shall be graded to levels, and profiles, (cross falls, camber, etc.) shown on drawings or directed by the Engineer. If sub-base finish is not executed to the satisfaction of the Engineer, the contractor shall scarify, grade, re-compact and finish the surface at his own cost and to the Engineer's approval.

Sub-base work shall be measured by the volume of material cut and filled in naturally occurring sub-base base, and the volume of filed material in improved sub-base and shall be understood as including all related work.

1634 Drainage Ditches

Drainage ditches shall be cut & shaped to the sections and profiles shown on drawings. Drainage ditches shall be measured by the volume of excavation and fill and understood as including, compaction & shaping.

1635 Gravel Wearing Course

Gravel wearing course is the top surfacing course made from naturally occurring or crushed gravel and shall be applied to road formation where no concrete or bitumen surfacing is to be applied.

The material for wearing course shall have a plasticity index of 5-25, maximum Los Angeles abrasion and aggregate crushing value of 50 & 35 respectively and 4 days soak CBR of 80.

The grading curve of the material, after processing and compaction shall be a smooth curve with the following envelope.

Sieve size	Percentage by Weight passing
1/2"	100
3/4"	65-95
3/8"	40-70
No4	30-55
No10	20-40
No20	15-32
No60	10-24
No200	4-10

Wearing course shall be deposited and spread in a uniform layer across the full width and compacted and finished to the profiles shown on drawings.

Wearing courses shall be measured by area specifying thickness and shall be understood as including all related work.

Grass & plant showing defects at the end of the maintenance period shall be replanted and maintained by the Contractor for an equal maintenance period as the initial agreement at no cost to the Investor.

1636 Asphalt Paving

16361 General

The final levels of sub-base shall be checked for compliance with Section 1633 of this Specification prior to the placement of bituminous paving.

Adequate precaution shall be taken to ensure that asphalt work is not sprayed during rainy weather and while the sub-base is excessively wet.

16362 Asphalt paving shall be constructed as follows:-

The base coarse shall be in penetration macadam course of 70mm thickness placing 40-70mm rise crushed gravel laid on sub-base/hard-core. Compact by using 8 passes of a 12 ton roller and adjust final level with + 10mm.

The surface shall be treated with AC - 85/100 or other specified hot bitumen at the rate shown in drawings or schedules. The surface, shall while hot, be covered with 8 - 12mm crushed gravel and rolled until gravel is firm is position and no movement is noticed under the roller.

The surface course to be applied after 10 days (during the time when base-course is open to traffic) shall consist of a 20mm wearing course applied as follows: -

Apply hot bitumen AC-180/200 or other specified at the rate shown in drawing or schedules and spread evenly.

The surface shall, while hot be covered with stone chipping of 8 - 12mm and rolled thoroughly. Check road level for uniformity.

A fine spray of AC-180/200 or other specified shall be applied at the rate shown in drawings or schedules and covered with 3 - 5mm stone chipping and rolled with a 10-16ton roller for a minimum pass of 4 times.

The final level shall be checked for required accuracy.

16363 Asphalt paving shall be measured by area.

1637 Asphalt Concrete Paving

16371 General

163712 Work included

Provide all material, labour and equipment for the satisfactory execution of asphalt concrete paving including the following.

- Final preparation of sub grade;
- Soil sterilization under pavement;
- Aggregate base course;
- Asphalt surfacing materials;
- Placing asphalt concrete;
- Flood test;
- Seal coat;

163712 Related work described elsewhere

Excavating, filling and grading in this section & earthwork section 02.

163713 Qualifications of workmen

Provide at least one person who is thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of work described in this Section, and who shall be present at all times during progress of the work of this Section and shall direct all work performed under this Section.

Use only personnel who are thoroughly trained and experienced in the skills required for execution of asphalt concrete work.

163714 Product handling

163715 Protection

Use all means necessary to protect the materials of this Section before, during, and after installation.

163716 Replacements

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Investor.

16372 Products

Soil sterilizer shall be a compound of sodium chlorinate.

The base course shall be in mineral aggregate course of 50-70mm rise laid on prepared sub-base.

Asphalt surfacing materials shall be asphalt concrete consisting of a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within the following limits:

Sieve sizes	Percentage passing
3/4"	. 100%
3/8"	67 - 85%
1/4"	50 - 65%
No. 8	37 - 50%
No. 30	15 - 25%
No. 200	3 - 8%

Plus 50/60 penetration liquid asphalt at 5% to 6-1/2% of the combined dry aggregates.
All asphalt concrete shall be hot plant mixed.

The aggregates shall have a temperature between 135 and 160 degree centigrade when placed in the mixer. The liquid asphalt shall be heated to a temperature between 135 and 160 degree centigrade, and shall be added during mixing.
Mix the combined aggregates and liquid asphalt in a pug mill mixer. Continue the mixing for at least 45 seconds after all ingredients have been placed in the mixture, and until the liquid asphalt is distributed uniformly throughout the mixture.

The mixture shall have a temperature between 145 and 160 degree centigrade when it leaves the plant.

16373 Execution

163731 Preparation

Examine the areas and conditions under which work of this Section is to be installed. Correct conditions detrimental to proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

After preparation of sub-grade thoroughly scarify and sprinkle the entire area to be paved, and then compact by rolling to a smooth, hard, even surfaces of 95%MDD compaction to receive the aggregate base. Finish to the required grades, with due allowance for the thickness of base and finished surfacing to be placed thereon.

163732 Equipment

Compacting equipment shall be self-propelled tandem rollers having a minimum weight of ten tons, except that hand-held vibrator compacters may be used in areas not accessible to rollers when specially approved by the Engineer.

Coating equipment: all equipment for line painting, soil sterilizing, and seal coating shall be specifically designed for that purpose and shall be subject to the inspection and approval of the Engineer.

Paving equipment shall be spreading, self-propelled asphalt paving machine capable of maintaining line, grade, and the minimum surface thickness specified, except the spreader boxes that may be used in areas where specifically approved by the Engineer.

16373 Laying of Base Course

After completion of sterilizing operations, place the specified base material over all areas to be paved.

Wet and compact the base material, using only the amount of water needed to secure optimum moisture content and compaction of 95%MDD.

Bring the compacted base finish to a uniformly smooth and hard surface conforming to the lines, grades, elevations, and cross sections shown on the drawings.

16374 Placement of Asphalt Concrete

Do not spread material unless it has a temperature of at least 140 degree centigrade at the time of unloading.
Asphalt concrete shall not be placed during fog, rain, or on wet base course and during all unsuitable condition.
Material shall be spread in a manner, which requires the least handling.
Where thickness of finished pavement is less the 50mm spreading shall be in one layer.

16375 Rolling

After the material has been spread to the proper depth, roll with the specified equipment until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the Drawings.
Roll the surface in at least two directions until no roller marks are visible.

16376 Flood Test

Flood test shall be performed in the presence of the Engineer. Perform the flooding by use of water truck.

If a depression is found where water ponds to a depth of more than 3mm, fill or otherwise correct to provide proper drainage.

Feather and smooth the degree of fill so that the joint between fill and original surface is invisible.

164 LANDSCAPING

1641 General

Land preparation and planting shall be executed at all times under the guidance of an experienced workman, who is thoroughly familiar with land preparation for gardening, plants and their method of planting and the maintenance at work completion.

Grass & plant

Planting shall generally be executed by sub-contractors experienced in landscaping.

Plant material shall be delivered to meet or exceed the plant specification given in drawings and schedules. Grass shall be free from noxious weeds.

1642 Land Preparation

The area to be planted shall be graded to the profiles shown on landscape drawings.
Plant beds shall be graded to ensure that no ridges or depression (other than those on drawings) are formed and area is left in smooth and firm plane that ensures proper drainage and no future settlement of the soil.

The top layer shall be fine graded using suitable top soil obtained from site or imported from appropriate location.

1643 Planting

Plants shall be set in positions in the center of holes and the holes back filled around the roots. Grass shall be sown or planted with approved seed or grass type.

All plant & grass shall be protected by erecting temporary fences or barricades, signs and other protection as needed to prevent trampling.

1644 Maintenance

Plant shall be watered, weeds removed and cultivated to keep the plant in healthy growing conditions.

The plant shall be maintained to the agreed maintenance period or to the end of the construction maintenance period if no separate maintenance period is agreed.

Grass & plant showing defects at the end of the maintenance period shall be replanted and maintained by the Contractor for an equal maintenance period as the initial agreement at no cost to the Investor.