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**MINISTRY OF HEALTH**

**Bidding Document**

**for the**

**Procurement of Works**

**VOLUME 3 OF 4**

**(SPECIFICATIONS)**

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## **DOCUMENTS SUMMARY PAGE**

**Volume 1 of 4: Bidding procedures, employer's requirements and conditions of contract & contract forms**

**Volume 2 of 4: Bills of quantities**

**Volume 3 of 4: Technical Specifications comprising:**

**(A) Standard Specifications for Building works**

**(B) Code for Electrical Installations in Buildings**

**Volume 4 of 4: Drawings**

**FLYSHEET:**

**Volume 3A of 4 - Standard  
Specifications for Building works**



THE REPUBLIC OF UGANDA

MINISTRY OF WORKS AND TRANSPORT

# STANDARD SPECIFICATIONS

**BUILDING WORKS**

**B4**



## **FOREWORD**

The mission of the Ministry of Works and Transport (MoWT) is to promote an adequate, safe and well maintained works and transport infrastructure and services so as to effectively contribute to the socio-economic development of the country.

In exercising this mission and in discharging its responsibilities, the Ministry is issuing a series of Design Manuals, Guidelines, Codes and Standards, of which the “Standard Specifications for Building Works” is one part thereof.

The Standard Specifications for Building Works will be a nationally recognized document which will serve as a standard reference for the preparation of specifications for works to be undertaken on building construction projects.

The major benefits to be gained in applying this document are the harmonization of professional practice in the building construction in Uganda and curtailment of informal developments so as to ensure well-planned, well-maintained, safe, cost effective and decent building developments and human settlements throughout the country.

The Standard Specifications will be periodically updated and new editions issued to cater for the dynamic technological developments in the construction industry.

**Abraham Byandala**  
**Minister of Works and Transport**

**December 2012**

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# **PART 1**

# **ARCHITECTURAL, STRUCTURAL AND GENERAL WORKS**

## **1.0 GENERAL MATTERS**

### **1.1 General Conditions of Contract**

All clauses, definitions and procedures described in the General Conditions of Contract for the Procurement of Works, issued by the Public Procurement and Disposal of Public Assets Authority (PPDA) in June 2003 will apply to these specifications unless specifically ruled otherwise in Special Conditions of Contract.

### **1.2 Instructions to Bidders**

All clauses, definitions and instructions issued in the Invitation to Bid and Instructions to Bidders will apply to these specifications unless otherwise ruled in the Bid Data Sheet/Bidding Data of the Bidding Documents

### **1.3 Scope of Contractor's Obligations**

The Contractor shall provide everything necessary for the proper execution and completion of the works, according to these specifications, the particular specification and/or the bills of quantities whether the same is particularly described or not.

The Contractor shall provide all labour, carriage, freightage, building materials, implements, tools, tackle and plant and whatever else may be required for the proper and efficient execution and completion of the works.

The Contractor shall obtain necessary consents, pay any charges for, provide, erect, maintain and remove all necessary self supporting and other scaffolding, staging, gangways etc together with the necessary planks, ladders, trestles, etc. for the use of all trades engaged upon the buildings.

The Contractor shall provide, erect, maintain and alter as necessary and remove on completion all internal scaffolding, planks, trestles, ladders etc to all floors for the use of all trades engaged upon the building.

The Contractor shall include in his rates, unit prices or tender for all charges for waste, establishment and overhead charges and profit.

### **1.4 Interpretation of Terms**

Wherever the words – 'selected' as 'directed' 'as required', or words of similar meaning are used in these documents, it is to be understood that the selection, direction or requirements of the Project Manager are intended. Similarly the words 'approved', 'satisfactory' or other synonyms shall mean 'approved by' or 'satisfactory to' the Project Manager and the Project Manager's approval must first be obtained before the materials are ordered or the works to which the words refer are put in hand.

Where the words 'necessary', 'proper' or words of similar meaning are used in these documents with respect to the extent conduct or character or work described, it is to be understood that they shall mean that the said work shall be executed to the extent, must be conducted in a manner or be of a character which is 'necessary' or 'proper' in the opinion of the Project Manager.

## 1.5 Workmanship

All workmanship shall be carried out by skilled operatives well versed in their respective trades.

All persons carrying out Plumbing and Drainage works shall hold licenses for carrying out such work in accordance with Section 1.2.4 of the Uganda Code for Sanitary Installations in Buildings.

## 1.6 Codes of Practices

Where certain classes of work are described as in accordance with a Code of Practice or Standard, this shall be understood to mean the most recent and up to date editions of the Codes of Practices or Standards referred to. Where a Uganda Standard is not in existence, the most recent version of the British Standard as published by the Council for Codes of Practice, British Standards Institutions or such other Code of Practice as shall be expressly stated herein by the Project Manager may be applied.

## 1.7 Materials

All materials shall be new unless otherwise directed or permitted by the Project Manager and in all cases where the quality of goods or materials is not described or otherwise specified is to be the best quality obtainable in the ordinary meaning of the word 'best' and not merely a trade signification of that word.

A reference to Standard Specification shall be understood to mean the most recent and up to date edition of that specification as published by the Ministry responsible for Works

In absence of a specification of intended material does not exist in that Standard Specification, reference to a British Standard Specification may used and shall be understood to mean the most recent and up to date edition of that specification as published by the British Standard Institution. The initials 'B.S.' used in this document are the abbreviated form of British Standard Specification.

The Project Manager reserves the right to substitute, amend, alter, enlarge upon, correct or revise any of the foregoing and where this is intended it will be expressly stated herein.

## 1.8 Ordering of Materials

The Contractor shall be solely responsible for ordering all materials required for use on the works.

The Contractor shall order all material, other than those covered by Prime Cost or Provisional Sums, as early as necessary after the Contract is signed to ensure that such material will be on site when required for incorporation in the works.

Materials which are the subject of Prime Cost or Provisional sums in these documents shall be ordered immediately after written instructions are received to do so from the Project Manager.



The Contractor is to take his own measurements for the ordering of materials. No responsibility will be accepted by Government for surplus, shortage, loss or expense if the goods are wrongly ordered.

The Contractor shall be responsible for and shall replace or make good at his own expense any materials lost or damaged, no matter how arising.

### **1.9 Proprietary of Materials**

All proprietary materials and goods, i.e. those specified to be obtained from a particular manufacturer shall be used and fixed strictly in accordance with their instructions.

Where proprietary materials are specified hereafter the Contractor may propose the use of materials of other manufacture and equal quality for approval by the Project Manager. If such approval is given, in writing, then these alternative materials may be incorporated in the works at no extra cost to the Government.

### **1.10 Samples**

The Contractor shall furnish at the earliest possible opportunity before work commences and at this own cost, any samples of materials or workmanship that may be called for by the Project Manager for his approval or rejection and any further samples in the case of rejection until such samples are approved. Such samples when approved shall be of not less than the minimum standard for the work to which they apply.

Samples shall be as representative as possible and no attempt shall be made to be unduly selective, samples shall be taken separately from a number of places in a particular load, heap, stock pile, batch deposit pit or suppliers store as the case may be, as directed by the Project Manager.

### **1.11 Prove Vouchers**

The contractor shall upon, request by the Project Manager, furnish vouchers to prove that materials are being supplied in accordance with the specifications.

### **1.12 Tests**

The Project Manager shall, as stated in the GCC, clause 34, be at liberty to make all tests necessary in order to satisfy himself that the materials and workmanship of every kind are in accordance with the Specification.

Where tests are carried out on the Works or samples taken by the Project Manager, the Contractor shall give all necessary assistance when called upon to do so.

The testing of materials will, unless expressly stated to the contrary, be carried out either by the Chief Materials Engineer of the Ministry responsible for Works at the Central Materials Laboratory, Kampala, or equivalent laboratory as determined by the Project Manager. Tests may also be carried out by Project Manager or his representative on site when adequate facilities for such site tests exist.

### 1.13 Payment for Tests

In case the Contract Documents include a Provisional Sum to meet the cost of testing all materials other than concrete work cube tests as later described.

The Contractor shall keep an accurate record of the costs incurred in the successful testing of materials and such costs will be adjusted in the final account and set off against the Provisional sum.

The Contractor will not be paid for unsuccessful tests due to the submission of materials which for any reason whatsoever are not of the required standard.

### 1.14 Test Samples

Each sample submitted to the laboratory for testing shall be properly packed, adequately labeled and have affixed to it the following information for the purposes of identification:-

- (a) Name of project and location
- (b) Type of material
- (c) Intended use
- (d) Date sample taken
- (e) By whom sampled
- (f) In cases of aggregate or other naturally occurring material, the location of the pit or deposit.
- (g) Name of contractor and contractor's sample reference number.

### 1.15 Rejected Workmanship and Materials

Any workmanship or materials not complying with the requirements of the specification or approved samples which have been damaged, contaminated or have deteriorated, must be immediately removed from the site and replaced at the Contractor's expense, as directed by the Project Manager.

### 1.16 Materials intended for the Works

No timber or other materials required in the permanent construction of the works will be allowed to be used as plant or scaffolding.

### 1.17 Overtime or Nightwork

If the Contractor determines for the purpose of expediting the Works or for any other reason to permit the working of overtime or nightwork necessary so that the works or any part thereof, shall be completed in every respect ready for occupation and use within the time stated, he must include for same in his tender as no extra payment will be allowed for this at the settlement of the accounts.

When the Project Manager directs the Contractor in writing, for any reasons whatsoever; to carry out work outside normal working hours, he will be reimbursed the net difference in cost between the operatives normal hourly or daily rate of pay and the enhanced overtime rate where this applies.

### **1.18 Nuisance to Adjoining Buildings and Property**

The Contractor is to make every reasonable and practical effort, consistent with good and expeditious work, to avoid nuisance from noise, dust, transport or any other cause to the occupants of existing buildings and adjoining property and to the public generally.

### **1.19 Existing and Adjacent Property**

The Contractor must take all steps necessary to safeguard the existing property and adjacent property, make good at his own expense any injury to persons or damage to property caused thereon, and hold the Government indemnified against any such claim arising.

The Contractor shall take all necessary precautions to avoid damage to the surrounding ground, grass, plants, shrubs and trees and reinstate at his own expense any damage caused thereto.

### **1.20 Damage to Public and Private Roads**

The Contractor will be required to make good at his own expense, any damage he may cause to the present road surfaces and pavements during the period of the works.

### **1.21 Existing Services**

Prior to commencement of any work the Contractor is to ascertain from the relevant Authorities the exact position, depth and level of all existing electric and telephone cables water pipes or other services in the area and he shall make whatever provisions may be required by the Authorities concerned for the support and protection of such services. Any damage or disturbance caused to any service shall be reported immediately to the Project Manager and the relevant authority and shall be made good to their satisfaction at the Contractor's expense.

### **1.22 Watching and Lighting**

The Contractor shall provide at his own cost all requisite day and night watching and lighting including that for use by his Sub-Contractors, whether nominated or otherwise and everything else necessary for the protection and security of the Works, plant, materials on site, the Public, and all persons lawfully using the premises during the execution of the works.

The Contractor shall provide red warning lamps at night to all obstructions and excavations either on, in or adjacent to the public highway.

### **1.23 Licenses and Permits**

The Contractor must ensure that he, as sole proprietor or as an authorized director of his company and his workpeople are in possession

He must also ensure that he or his suppliers are in possession of valid import licences for materials which are required to be obtained from outside Uganda.

## 1.24 Notices and Fees

The Contractor shall allow for giving all notices to Public Authorities and Statutory undertakings and for payment all fees and charges legally demandable. (see separate clause regarding water charges).

## 1.25 Definition of "Fix only"

For all items described in these documents as 'Fix only' the Contractor shall allow in addition to the foregoing for taking delivery where directed, checking with invoices or indents, reporting and claiming damages for shortages and damaged goods, defraying demurrage charges, transporting, unloading, storing and protecting until the time of fixing, unpacking, replacing anything lost or damaged, sorting, assembling, distributing, hoisting to required levels and fixing complete in accordance with the directions supplied or specified.

## 1.26 Attendance of Nominated Sub-Contractors

The Contractor shall afford both **general and specific** attendance upon all Nominated sub-contractors, specialists and other executing works for which prime cost or provisional sums or prices are included hereafter.

The Contractor shall give such facilities to all firms employed upon the Works as the Project Manager considers reasonable and afford them use of scaffolding and ladders, alter standing scaffolding as required, or erect and remove any special scaffolding which they may require for the purpose of carrying out their work, supply them with labour and tackle for unloading, getting in, storing, hoisting and distributing their materials, use of electric light, power, and water and allow them use of storage for their materials, and the use by the Nominated Sub-Contractors employees of all messrooms, sanitary accommodation and welfare facilities and clear away all rubbish.

The Contractor shall give Nominated Sub-Contractors and other parties working on the premises all information reasonably necessary to enable them to properly set out and execute their work in harmony with the surroundings and other trades, and is not to allow them to proceed otherwise.

The Contractor shall be responsible in every respect for Nominated Sub-Contractors and in particular to see that their work proceeds regularly with the general progress of the building works and in accordance with the Works Program or Implementation Schedule.

The value of the foregoing services to be rendered by the Contractor to the Sub-Contractors, as described in this Clause is to be allowed for in the Bills of Quantities or particular specification under the item "Attendance" which follows each Prime Cost or Provisional Sum.

The Contractor shall allow for hacking surfaces to receive special finishes as required by Nominated Sub-Contractors.

## 1.27 Temporary Roads

The Contractor shall provide and maintain as necessary, all temporary roads, ramps, hard-standing, tracks, crossings and the like for the efficient running of the Works for all vehicles entering and on the site, including those of Nominated Sub-Contractors and afterwards remove and reinstate the ground to its original condition if so directed by the Project Manager.

### **1.28 Temporary Fencing**

The Contractor will not, unless otherwise expressly instructed in the Contract Documents, be expected to provide a temporary fence or hoarding around the site. He will however be required to afford adequate protection and security from theft or other loss by the provision of a safe area or compound for the storage of materials which cannot be properly stored in a lockable store as provided hereafter. The compound must be properly constructed and have adequate means of access and locking facilities and afterwards it must be dismantled and clear away from the site.

### **1.29 Storage of Materials**

The Contractor shall provide erect and maintain and clear away on completion suitable watertight sheds and other protection for the storage of materials including those of all Sub-Contractors.

Floors of sheds used for the storage of cement and other perishable materials shall be raised at least 150 mm above ground level. Cement stacks or bags shall be placed on timber pallets approved by the Project Manager.

### **1.30 Sheds for Operatives**

The Contractor shall similarly provide suitable watertight sheds for the use of the operatives and those of all Sub-Contractors.

### **1.31 Site Office**

The Contractor shall provide erect and maintain and clear away on completion suitable watertight temporary office accommodation for the use of his site staff and a similar separate-office for the use of the Project Manager's Supervising Officer.

Each office shall be of suitable size for the purpose for which it is intended and shall have a lockable door, windows of a size proportionate to the floor area, adequate means of ventilation, and be fitted with a desk with a drawer for the storage of plans and chair for the use of the staff.

### **1.32 Site Meetings**

Site Meetings will be held in the Site Office at intervals as directed and the contractor will be required to summon the attendance of Sub-Contractors and specialists, prepare and distribute minutes and generally organize the meetings.

### **1.33 Works Diary**

The Project Manager will issue to the Contractor one copy of the Standard Works Diary which shall be kept on the site at all times.

### **1.34 Foreman-in-Charge**

The Contractor shall keep a Foreman-in-Charge in constant attendance upon the works. He shall be capable of reading, writing and speaking English and he shall keep copies of all drawings; details, specifications, letters, instructions, etc. on the works.

He shall also be required to keep a day today record in the Works Diary of the weather on the site.

### **1.35 Temporary Latrines and Ablutions**

The Contractor shall provide the necessary temporary latrines, water closets and ablutions for his staff and workmen to the requirements and satisfaction of the Health Authorities and maintain the same in a thoroughly clean and sanitary condition and pay all conservancy fees and connection charges during the period of the Works and remove when no longer required and make good all distributed surfaces.

### **1.36 Water for Works**

The Contractor shall provide at his own risk and cost all water for use in connection with the Works (including the work of Sub-Contractors whether Nominated or otherwise). Where a mains supply is not available locally he will be required to bring in water by tanker or other approved method and pay all costs and fees in connection therewith. He shall also provide temporary storage tanks and tubing, etc. as he may consider necessary and clear way at completion.

All water shall be fresh, clear and pure, free from earthly vegetable or organic matter, acid or alkaline substance, in solution or suspension.

### **1.37 Light and Power for the Works**

The Contractor shall provide all artificial lighting and power for use on the Works, including all Sub-Contractors and Specialists whether nominated or otherwise, requirements and including all temporary connections, wiring, fittings etc and clear away on completion. The Contractor shall pay all fees and obtain all permits in connection therewith.

Before submitting his tender the Contractor must ascertain for himself whether a supply will be available or not at commencement of or during the course of the Works as no claim will be entertained due to failure by *UMEME* provide such a supply.

### **1.38 Signboards**

The Contractor shall provide, erect and clear away on completion a signboard for the display of the General Contractor's names which shall be of an approved size and design with the Employers' names painted thereon.

Particulars of all parties to the contract shall be given and words shall be printed in a minimum size of 50 mm letters. No other signboard or advertising signs shall be permitted without the permission of the Project Manager.

### **1.39 Protection of Works**

The Contractor shall allow for covering up and protecting the Works during inclement weather and provision of all temporary covers, gutters, down pipes surface water drains, etc. as required.

### **1.40 Keeping and Delivering Site and Works Clean**

He will also allow for carefully protecting all work including all Sub-Contractors Work liable to injury and provide all necessary temporary casing, linings, coverings to steps, floors, tiles, paving, walls, ceilings, fittings and fixtures of all kinds to the complete satisfaction of the Project Manager and finally clear all away on completion.

### **1.41 Contingencies**

The Contractor shall allow for cleaning out drains, gullies, interceptors, manholes, etc. Cleaning glass inside and out, cleaning metalwork and woodwork, sweeping and scrubbing all floors pavings etc. or treating with special finishes as described, cleaning all cisterns, sanitary fittings, etc, testing all water supplies, cisterns and sanitary fittings and leaving drip dry, oiling all door and window hinges, bolts and locks and removing all paint and cement stains and clear and cart away all rubbish as it accumulates to a tip to be provided by the Contractor and leave the whole of the site and Works clean and tidy ready for occupation to the complete satisfaction of the Project Manager.

The Contractor shall include in his Tender the Contingency Sum as directed in the Particular Specification or Bills of Quantities which will be used as directed by the Project Manager and deducted in whole or in part if not required.

## **2.0 WORKS OF DEMOLITION AND ALTERATIONS**

### **2.1 Demolition**

All taking down and demolition is to be carried out without damage to the remaining structures or the adjoining property. Where any such damage occurs the Contractor shall reinstate and make good at his own expense

### **2.2 Obstruction of Public Road etc**

The Contractor shall not obstruct the Public Thoroughfares or Private Rights of Way without the approval of the Local authority and shall pay all their charges and conform to all instructions issued by them.

### **2.3 Prevention of Dust and Fans**

The Contractor shall thoroughly water the work during all demolition to prevent any nuisance from dust, dirt, etc., and is to provide all necessary protecting fans, barricades, dust sheets, tarpaulins etc to protect the new and existing work, the public, the occupants and the workmen.

### **2.4 Removal of Rubbish**

All items of taking down etc., shall be included for removing, basketting, getting out and clearing away from site all debris and rubbish whether specifically mentioned or not from the relevant floor levels.

### **2.5 Disposal of Rubbish**

The Contractor shall make his own arrangements for a shoot or spoil heap for disposal of all materials arising from demolition works and he is to pay all charges in connection therewith

### **2.6 Use of Suitable Material for Hardcore**

The Contractor may use the broken brick and other approved material arising from the pulling as hardcore filling under floors, paths etc., provided such materials are suitably broken down and cleaned to the approval of the Project Manager.

### **2.7 Dustproof Screens**

The Contractor shall allow for providing and fixing temporary waterproof and dustproof screens, coverings, etc. to all sections of the existing building, which may be exposed by reason of the pulling down and shall efficiently keep the premises watertight and dust free whilst building work is in progress.

### **2.8 Shoring**

The Contractor's price for shoring where described shall include for all shoring, needling, strutting etc., to all walls, floors, roofs, etc., as required, altering and adapting same as necessary and the Contractor shall be responsible for the sufficiency and maintenance of the same and removal when no longer required and making good all works disturbed at completion.



## **2.9 Building Openings**

The Contractor's price for building up openings in existing walls shall include for all temporary strutting to heads, preparing jambs, oils and wedging and pinning at heads.

## **2.10 Cutting Openings in Existing Walls**

The Contractor's prices for cutting openings etc., in external walls at various floor levels and all other works necessitated shall be deemed to include for all necessary scaffolding, ladders, etc.

Similarly, this shall equally apply to the Contractor's prices for external painting.

## **2.11 Existing Public Service Mains**

The contractor is to allow for protecting supporting or diverting as required any Public Service Mains encountered during the execution of the works or he must allow for and pay all fees chargeable if this work is executed by the Public Authorities concerned.

## **2.12 Government to Retain Ownership of Old Materials**

Where materials as described "to set aside for re-use" they shall remain the property of the Government and shall be carefully preserved by the Contractor and loaded and carted to a store where directed by the Project Manager, and the Contractor shall allow in his prices for this activity.

## **2.13 Materials to be Cleared Away**

All old materials described to be "cleared away" shall become the property of the Contractor and shall be removed from the site by him and he is to state in the place provided any credit he is prepared to allow. The Government reserves the right, however, to retain ownership in any of the materials arising from the pulling down and the Contractor will be reimbursed at the credit value he has allowed for those materials.

## **2.14 Definiton of "Make Out"and "Make Good"**

The terms "make out" and "make good" shall be read as including all necessary labour and new materials required to match in every respect the existing surrounding work, unless the same are described as 'measured separately'.

## **3.0 EXCAVATION**

### **3.1 Clearance of Site**

Clearance of the site of the Works shall be done to the extent as directed by the Project Manager but not otherwise. This shall include demolition and removal of all obstruction, removal of rubbish, cutting down vegetation, shrubs, bushes and trees and grubbing up stumps and roots and burning or clearing away from site, as appropriate. Holes made in grubbing up stumps and roots shall be filled in and rammed solid with approved material deposited in layers not exceeding 150mm thick.

### **3.2 Trees and Bushes to be Preserved**

Trees and bushes which are to be preserved shall be marked with paint by the Project Manager's Supervising Officer on site and the Contractor shall carefully protect these as required until completion of the Works.

### **3.3 Felling Trees**

All useable timber trees shall remain the property of the Government. Trees shall be cut down as near to the ground as possible, leaves and branches removed and burnt, and useful trunks cut into suitable lengths and removed and placed in stocks on the site where directed.

### **3.4 Anthills**

All anthills, nests, queen ants and grubs shall be removed as necessary, and the ground sterilized either by lighting fires and burning for not less than 24 hours or use of an approved insecticide, and filling any holes excavated with approved material, rammed solid in layers not exceeding 150 mm thick.

### **3.5 Removal of Vegetable Soil**

The Contractor shall excavate over surface of site of roads, paths, embankments, terraces, etc., and to a distance of not less than 3 m around any building, and remove vegetation and top soil to a depth of not less than 150 mm below the average existing ground level or to such other average existing ground level or to such other depth as directed by the Project Manager, Vegetable soil shall be removed to a spoil heap within the boundary of the site or as otherwise directed and carefully preserved for reuse in top soiling to embankments and areas of cut or fill.

### **3.6 Excavation to Reduce Level**

The Contractor shall excavate over surface of site to reduce level and "get out". Formation level is deemed to be the underside or gravel/murram base courses of roads, hard standings and the like. Grassed areas or unpaved areas, are unless directed to the contrary to be reduced to 150 mm below finished ground levels to allow for the replacing of top soil for grassing.

### **3.7 Excavation for Embankments**

The Contractor shall excavate to reduce levels to form embankments where required and “get out”. Unless otherwise shown on the drawings the face of the embankment shall be finished to an even slope not greater than 2:5.

### **3.8 Excavation for Foundations**

The Contractor shall excavate for basements, foundation, ducts, pier holes, stanchion bases, etc., all to the widths and depths as shown on the drawings or as directed by the Project Manager.

### **3.9 Steps in Foundations**

Steps in foundations shall be provided in accordance with the drawings or the Project Manager’s instructions.

### **3.10 Excess Excavations**

The Contractor shall level or trim to falls and cross falls as indicated on the drawings, ram and consolidate the surface of the ground and bottom of all excavations to receive concrete foundations, beds, etc.

### **3.11 Bottoms of Excavations to be Approved**

The bottom of all excavations and ground surfaces under foundations, beds and the like shall be inspected and approved by the Project Manager before concrete or hardcore is laid.

### **3.12 Soft Spots**

Where pockets of soft or other unsuitable material are found to extend below the approved foundation or formation level, the pockets shall be removed to such extent and levels as directed by the Project Manager and filled up to the underside of the adjacent foundations, with concrete mix ‘E’ as later described in the case of concrete work or with approved excavated material when under hardcore beds.

### **3.13 Excess Excavations**

Should any excavation be made below the depths shown or required to obtain a solid bottom, the Contractor shall fill up the excess excavation in the same manner as described for Soft Spots - Clause 3.12.

### **3.14 Working Space**

Where work carried out by other trades demand it, or when instructed by the Project Manager, the Contractor shall excavate working space sufficient to facilitate the proper carrying out of such work, i.e. vertical tanking, formwork to ground beams, etc.

### **3.15 Excavation in Rock**

The Contractor's prices for all excavation work will be deemed to include for excavations in any material other than solid rock.

### **3.16 Definition of Solid Rock**

Solid rock shall mean any naturally occurring material found in ledges or masses in its original position which can only be extracted by the use of compressors or by blasting, and also solid boulders or detached pieces of rock in size:-

- (i) Exceeding 0.25 m<sup>3</sup> in trenches.
- (ii) Exceeding 1.25 m<sup>3</sup> in general excavation

### **3.17 Determination of Rock Excavation**

The Contractor shall inform the Project Manager as soon as solid rock is exposed so that the Project Manager can inspect and determine that the material is in accordance with the definition in Clause 3.16 above and then instruct the Contractor to remove it or cause a redesign of the affected foundation works as he sees fit.

### **3.18 Payment for Rock Excavation**

The Contractor shall be paid extra for the removal of solid rock so defined at the rates inserted by him in the Contract Documents or, in the absence of such rates, by rates to be agreed with the Project Manager. The "extra" rates for rock excavation shall include for excavating with compressors or for blasting, if allowed, and the extra cost of leveling, trimming and disposal.

### **3.19 Blasting**

Blasting shall be allowed only when expressly authorized by the Project Manager.

If in his opinion it would be dangerous to persons or adjacent buildings to blast or if blasting has been authorised and is being carried out in a reckless or dangerous manner he may prohibit it and order the rock to be excavated by other means.

The greatest care shall be taken by the contractor when blasting to ensure that no injury be done to persons or any finished work. The shorts shall be properly loaded and covers and lonely moderate charges shall be used and where directed by the Project Manager the Contractor shall provide heavy mesh blasting nets or blast mounds. Blasting shall be restricted to such times as the Project Manager shall direct.

The Contractor shall make good at his own expense any damage resulting from blasting operations irrespective of whether the Project Manager has directed that special precautions be taken or not.

### **3.20 Returning, Filling and Ramming**

The Contractor shall return and fill selected excavated material around foundations, to backs of walls etc., up to formation level or as directed by the Project Manager, in layers not exceeding 230 mm thick, ram, consolidate and water it as required. No back filling shall be done until the foundation work

has been inspected and approved by the Project Manager.

### **3.21 Filling to Make-up Levels**

Filling to make up levels under floors, terraces and the like shall be done using selected excavated material. The material shall be wheeled from wherever it is located on the site and filled in layers not exceeding 150 mm thick each, watered as required and well rammed and consolidated up to the required levels.

### **3.22 Borrow Pits**

Where there is insufficient filling material arising from the excavations the Contractor shall be required to obtain it from other sources to make up the required quantity. The Contractor shall open up a suitable borrow pit, excavate as necessary, transport the material to site and deposit and fill as previously described.

### **3.23 Replacement of Vegetable Soil**

The Contractor shall remove vegetable soil from spoil heaps and wheel and deposit it over the area of excavated and filled areas around buildings including sloping faces of embankments to a finished depth of not less than 150 mm or to such other depth as directed by the Project Manager.

Any surplus vegetable soil shall be deposited, spread and leveled on site where directed. Under no circumstances is the contractor to sell, remove from site or otherwise dispose of vegetable soil.

### **3.24 Disposal of Surplus Excavated Material**

All surplus excavated material shall be wheeled, deposited, spread and leveled on site where directed by the Project Manager, or where otherwise expressly provided in these documents to be removed from the site to a tip to be provided by the Contractor who is required to pay any fees and charges in connection therewith.

### **3.25 Definition of "Get out"**

The term "get out" shall be construed as meaning all basketting out, and any re-excavation from spoil heaps which may be required in connection with items of filling and disposal.

### **3.26 Planking and Strutting**

The Contractor shall include for maintaining and upholding the sides of all excavations by means of planking and strutting or such other method as he deems necessary, including excavations next public roadways, filled areas and existing hardcore or any other material. No claim for additional excavation, concrete or other material required due to the Contractor's failure to observe this clause shall be allowed.

### 3.27 Keeping Excavations Free of Water

The Contractor shall keep the whole of the excavations free from water, silt and mud arising from surface water, rain, drains, floodwater or any other similar cause by baling, pumping, temporary drains or otherwise until completion of the Works. Where hidden underground springs are encountered or where foundations extend below the level of the water table which requires continuous pumping, the Contractor will, where this is properly authorised in writing by the Project Manager be paid for this at rates to be agreed for the use of such pumps.

### 3.28 Hardcore

The Contractor shall provide and lay hardcore beds under all concrete beds, pavings, etc., to the thickness as shown on the drawings.

Hardcore shall consist of approved hard dry broken brick rubble or crushed stone to pass a 65mm ring, laid in layers not exceeding 150 mm thick and each well watered, rammed and consolidated and leveled or finished to falls as shown on the drawings, blinded with fine stuff to receive concrete or other topping.

The Contractor shall form all sinking for ducts and thickenings in floor to the dimensions as indicated on the drawings.

### 3.29 Temporary Retaining Boards

The Contractor shall supply and maintain all temporary retaining boards for hardcore beds.

### 3.30 Anti-termite treatment

#### Pre - Construction Chemical Treatment In The Buildings

##### Scope:

This specification covers the general requirements for anti-termite constructional measures, chemical treatment of soils for the protection of buildings from attack by subterranean termites, chemicals to be used with their minimum rates of application and procedure to be followed while the building is under construction.

##### General:

The contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, and everything necessary whether or not such items are specifically stated herein for completion of the job in accordance with specification requirements.

All work shall be done in the order of progress required by Owner's construction programme. The contractor shall take all necessary precautions to prevent any accident in connection with the performance of the work. On final completion of all the work, the contractor shall leave the entire premises within the site of his operation clean and free from all rubbish resulting from his operation.

The owner reserves the right to inspect, check and direct any or all operations at any stage of the work and to require unsatisfactory work to be remedied at the contractor's expense. No work shall be carried out under

unsuitable weather conditions viz. when raining or when the soil is wet due to rain or sub-soil water.

Chemicals shall be brought to site of work in sealed original containers. The materials shall be brought in, at a time, in adequate quantity to suffice for the work. The materials shall be kept in cool and locked stores. The empties shall not be removed from the work site till the relevant item of work has been completed and permission granted by Owner / Engineer.

Chemicals available in concentration forms with concentration indicated on the sealed containers only shall be used. Chemicals shall be diluted with water in required quantity before use, using graduated containers to achieve the desired percentage of concentration:

Examples	:	Aldrin 20	-	1 lt. is diluted to 40 lts. to give 0.5% emulsion.
		Aldrin 18	-	1 lt. is diluted to 35 lts. to give 0.5% emulsion.
		Chlordane 20	-	1 lt. is diluted to 20 lts. to give 1.0% emulsion.

#### **Pre - constructional chemical treatment:**

##### **Essential requirements:**

Hand operated pressure pump with graduated containers shall be used to ensure uniform spraying of the chemicals. Continuous check shall be kept to ensure that the specified quantity of chemical is used for the required area during the operation.

##### **Condition of formation:**

The treated soil barrier shall be complete and continuous under the whole of the structure to be protected. All foundations shall be fully surrounded by and in close contact with the barrier of treated soil. Each part of the area treated shall receive the specified dosage of chemical.

##### **Time of application:**

Soil treatment shall start when the foundation trenches and pits are ready to receive mass concrete in foundations. Casting of mass concrete shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment shall not be carried out when it is raining or soil is wet with rain or sub-soil water. The same applies to the earth surface within the plinth before laying the sub-grade for the floor.

##### **Disturbance:**

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed immediate steps shall be taken to restore the continuity and completeness of the barrier system.

##### **Chemicals, method and rate of application:**

###### **A. Mound treatment:**

Termite mounds within the plinth and contingent apron area shall be destroyed by means of insecticides in the form of water suspension or

emulsion which shall be poured into the mounds at several places after breaking open the earthen structure and making holes with crow bars. For a mound volume of about one (1) cum, four (4) litres of an emulsion in water of one of the following shall be used.

- i. 0.25 % Aldrin
- ii. 0.25% Heptachlor
- iii. 0.5% Chlordane

**B. Soil treatment:**

Any one of the following chemical in water emulsion shall be applied uniformly over the area to be treated.

CHEMICAL	CONCENTRATION BY WEIGHT %
Aldrin	0.5
Heptachlor	0.5
Chlordane	1.0

**Treatment of column - pits, wall trenches and basement excavation:**

- a. The bottom surface and the sides (up to a height of about 300mm) of the excavation made for column pits, wall trenches and basements shall be treated with the chemical at the rate of 5 litres per Sq.M. of the surface area.
- b. After the column foundations and the retaining walls of the basement come up, the backfill in immediate contact with the foundation structure shall be treated at the rate of 15 litre / Sq.M. of the vertical surface of the sub-structure for each side. If water is used for ramming the earth-fill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150mm centres close to the wall surface and spraying the chemical with the above done. The earth shall be returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surface of the columns and wall so that the earth in contact with these surfaces is well treated with the chemical.
- c. In the case of RCC framed structures with columns and plinth beams and RCC basements, with concrete mix 1:2:4 or richer, the treatment shall start at the depth of 500 mm below ground level for columns and plinth beams. From this depth the back-fill around the columns, beams and RCC basement walls shall be treated at the rate of 15 litres / Sq.M. of vertical surface. The other details of treatment shall be as laid down in clause (b) above.

**Treatment of top surface of plinth filling:**

The top surface of the filled earth within plinth beams / walls shall be treated with chemical emulsion at the rate of 5 lts./Sq.M. of the surface before the sand bed/subgrade is laid. Holes up to 50 to 70mm deep at 150mm centres both ways shall be made with 12mm diameter crow-bar on the surface to facilitate saturation of the soil with chemical emulsion.

**Treatment of junction of wall and floor:**

To achieve continuity of vertical chemical barrier to inner wall surfaces from the ground level, small channel 30 x 30 mm shall be made at all the junctions



of wall and columns with the floor (before laying the subgrade) and rod holes made in the channel up to ground level 150mm apart and the chemical emulsion poured along the channel at the rate of 15 litres / Sq.M. of the vertical wall or column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after this operation.

#### **Treatment of soil under apron along external perimeter of building**

The top surface of the consolidated earth over which the apron is to be laid shall be reacted with chemical emulsion at the rate of 5 litres / Sq.M. of the surface before the apron is laid, by making rod holes 75 mm deep at 150mm centres both ways.

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so that children and pet cannot get at them. They shall be kept securely closed. Particular care shall be taken to prevent skin contact with concentration. Prolonged exposure to dilute emulsions shall also be avoided. Workers shall wear clean clothing and wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing shall be removed at once and the skin washed with soap and water. If chemicals splash into eyes they shall be flushed with plenty of soap and water and immediate medical attention shall be sought. The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames shall not be allowed during mixing. Care shall be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

#### **Measurements:**

The measurements shall be made in sq.m. on the basis of plinth area of the building at ground floor only for all operations described above. Nothing extra shall be measured.

#### **Rate:**

The rate shall include the cost of all materials and labour involved in all the operations described above including making holes and refilling and making good the same.

## 4.0 CONCRETE WORK

### 4.1 General Requirements

All concrete work shall be carried out in accordance with these specifications except that in the case of reinforced concrete the provisions of B.S 8110-1: 1997: Structural Use of Concrete - Part 1 : Code of Practice for Design and Construction shall apply in so far as they override, modify or supplement the clauses contained herein. The Contractor shall submit to the Project Manager full details of all materials which he proposes to use for making concrete.

### 4.2 Cement

The cement shall, unless specifically stated to the contrary, be common cement complying with the requirements of Uganda Standard US 310 – 1& 2: 2001. Where other cements are specified they shall comply with the requirements of the relevant European Norms (EN) Standards.

All cement shall be obtained from manufacturers in Uganda. Where cement is to be imported, prior approval of the Project Manager shall have to be obtained.

The Contractor shall supply, when requested by the Project Manager, test certificates relating to each type of cement used certifying that it complies with the appropriate Uganda Standard.

Unless approval is given for bulk handling, all cement shall be transported and delivered in sound and properly secured bags and stored in a dry, weatherproof, well ventilated shed with a raised floor or in such a building as is approved by the Project Manager.

Each delivery of cement in bags shall be stacked in one place. The bags shall be closely stacked to reduce air circulation but shall not be stacked against an outside wall. Where pallets are used, they shall be constructed so that the bags are not damaged during handling and stacking. No stack of cement bags shall exceed 3 m in height. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stacks. Cement in bags shall be used in the order in which it is delivered.

Bulk cement shall be stored in weatherproof silos, which shall bear a clear indication of the type of cement contained in them. Different types of cement shall not be mixed in the same silo.

Cement shall be delivered or stored on site in such quantities to ensure that the concrete work on any section of the Works can be carried out without interruption. Each consignment shall be kept separate and distinct.

Any cement that has been injuriously affected by dampness or any other cause shall not be used and shall immediately be removed from the site. Cement which has become hardened and lumpy shall be removed from site.

Cement which has been stored on site for longer than one month shall be tested at the Central Materials Laboratory of the Ministry responsible for Works or at the Uganda National Bureau of Standards Laboratories as directed by the Project Manager.

### 4.3 Aggregate for Concrete

Aggregates for concrete shall consist of clean natural sands, gravel, crushed stone or other material which have been approved for use by the Project Manager and shall apply in respect of quality with the requirement of BS EN 12620 "Coarse and Fine Aggregates from Natural Sources for Concrete".

Tests shall be made at frequent intervals or when called for to determine the amount of impurities in the aggregates and if ordered by the Project Manager fine aggregates shall be washed at the Contractor's own expense.

BS EN 12620 requires that aggregates shall be hard, durable clean and free from adherent coatings such as clay.

They shall not contain harmful materials such as iron pyrites, iron oxide, mica, shale or similar laminar materials, or flaky or elongated particles, in such a form or in sufficient quantity as to adversely affect the strength or durability of the concrete or any materials which might attach reinforcement where this is required.

The various sizes of particles of which an aggregate is composed shall be uniformly distributed throughout the mass. The quantities of clay, silt and fine dust shall not exceed:-

- (i) Sand or crushed gravel sand, 3% by weight when using the test given in BS 812 Clause 13
- (ii) Crushed stone sand, 5% by weight when using the test given in BS 812 Clause 12.
- (iii) Coarse aggregate, 1% by weight when using the test given in BS 812 Clause 13.
- (iv) All in aggregate, 2% by weight when using the test given in BS 812 Clause 13.

A guide to the silt and clay content of sand and crushed gravel sand can be obtained by the field settling test described in B.S. 812 Clause 14 when the silt and clay content should not exceed 65 by volume.

### 4.4 Grading of Aggregates

The grading of aggregates shall be within the limits in the following tables:-

**Table 4.4.1 Fine Aggregate**

B.S.Sieve	Percentage by weight passing B.S. Sieves			
	Grading Zone 1	Grading Zone 2	Grading Zone 3	Grading Zone 4
9 mm	100	100	100	100
4.5 mm	90-100	90-100	90-100	95-100
No. 7	60-75	75-100	85-100	95-1000
No. 14	30-70	55-90	75-100	80-100
No. 25	15-34	35-59	60-79	80-100
No. 52	5-20	10-30	15-40	15-50
No. 100	0-10*	0-10*	0-10*	0-15*

\* For crushed stone sands the permissible limit is increased to 20%

A fine aggregate whose grading falls outside the limits of any particular Grading Zone on sieves other than No. 25 by a total amount not exceeding 5% shall be regarded as being in that Grading Zone. The 5% can be split up, for example, as 1% on each of three sieves and 2% on another or 4% on one sieve and 1% on another, etc.

No tolerance is allowed for fine aggregate on the coarsest and finest limits of grading in all four Grading Zones.

Grading Zone 4 material should not be used in reinforced concrete unless tests have been made to ascertain the suitability of the proposed mix proportions.

#### 4.5 Sand

All sands for making mortar shall be clean well graded silicious sand of good, sharp, hard quality equal to samples which shall be deposited with and approved by the Project Manager. earth, loam, dust, salt, organic matter and any other deleterious substances, sieved

#### 4.6 Grading of Aggregates

Table 4.4.2 – Coarse Aggregates

Percentage by Weight Passing B.S. Sieves								
B. S Sieve	Nominal Size of Graded Aggregate							
	38 mm to 5 mm	19 mm to 5 mm	12 mm to 5 mm	64 mm	38 mm	19 mm	12 mm	9 mm
75 mm	100	-	-	10	-	-	-	-
64 mm	-	-	-	85-100	100	-	-	-
38 mm	95-100	100	-	0-30	85-100	100	-	-
19 mm	30-70	95-100	100	0-5	0-20	85-100	100	-
12 mm	-	-	90-100	-	-	-	85-100	100
9mm	10-35	22-55	40-85	-	0-5	0-20	0-45	85-100
5 mm	0.5	0-10	0-10	-	-	0-5	0-10	0-20
No. 7	-	-	-	-	-	-	-	0-5

The use of All-in aggregate may, with the specific approval of the Project Manager, be permitted in the case of mass concrete, unreinforced work etc., and where such approval is given the proportions of All-in aggregate to cement shall so gauged as to give a mix equivalent to that using separate aggregates.

The All-in aggregate shall comply with the requirements of B.S. 812 the grading being in accordance with the following table

Table 4.4.3 – All-in Aggregates

B.S Sieve	Percentage by Weight Passing B.S. Sieve	
	38 mm Nominal Size	19mm Nominal Size
78 mm	100	-
38 mm	95-100	100
19 mm	45-75	95-100
5 mm	25-45	30-50
No. 25	8-30	10-35
No. 100	0-6	0-6

#### 4.7 Maximum Sizes of Coarse Aggregates

The maximum size of the largest size coarse aggregate shall not be larger than a quarter of the least size of the member in which it is being used and at least 6 mm less than the smallest space between reinforcing bars where the member is reinforced.

#### 4.8 Storage of Aggregates

Aggregates of different sizes shall be stored in separate bins on hard clean floor free from contamination of any kind. Samples shall be supplied to the Project Manager for testing prior to the Works being commenced.

Aggregates shall be kept in sufficient quantity to enable the work on any section to be completed without interruption.

All aggregates shall be tested regularly as directed by the Project Manager, and any material which is below standard or which has become contaminated or adulterated in any way shall be immediately removed from the site.

Water for concrete mixing shall be from an approved source and shall be clean and free from acids, vegetable matter and any other deleterious material in solution or suspension. Potable water shall be suitable for concrete preparation.

#### 4.9 Concrete Mixes by Volume or Weight

The proportion for concrete mix sizes shall be specified either by:

- a) Volume
- b) Weight

Concrete mixes by volume will be permitted in the case of mass concrete work, unreinforced foundations and beds and for small isolated structural members such as lintels and isolated beams providing that in all cases the Project Manager is satisfied that the required strengths are being obtained.

Weight batching shall be used for all other concrete work in reinforced concrete ground beams, column bases, structural frames, floors, roofs, staircases, retaining walls and the like.

#### 4.10 Concrete Mixes

Concrete mixes shall be designed to satisfy the specified characteristic strengths. The mean strength of the designed mix shall exceed the specified

values by twice the expected standard deviation so as to take into account the inevitable variation.

Both fine and coarse aggregates shall be from natural sources and shall be graded such as to produce a concrete of specified proportions which will work readily into position without segregation and without excessive water content.

#### **4.10.1 Concrete Slump Test**

The slumps for concrete grades 15 – 30 N/mm<sup>2</sup> should be between 25 - 50mm. (I.S.E Manual)

### **4.11 Design Mixes**

The strengths attained for each mix shall be in accordance with those stated in Table 4.12.1 as described later.

If, because of the nature of the aggregates available, it becomes impossible to achieve the desired strength and workability, the Project Manager reserves the right to vary or “design” the mix proportion in order that concrete of the necessary quality will be produced.

The Contractor shall include for this and for a minimum increase of 10% in the cement content of any specified mix, whether by volume or weight, without extra charge.

### **4.12 Trial Mixes**

When directed by the Project Manager, the Trial Contractor shall make trial mixes for his approval mixes, before general manufacture of concrete commences.

Trial mixes shall be made using the identical plant and compaction methods which will be used in the works and deposited in suitable representative formwork.

Careful measurements of the cement, aggregate and water: cement ratios, slump and workability shall be made and the time of mixing noted for each mix.

Six “preliminary” test cubes shall also be made for each mix. Three cubes from each batch shall be tested for compressive strength at seven (7) days and the remaining three at twenty eight (28) days. The density of all the cubes shall be determined before the strength tests are carried out.

Mixes shall be made in such numbers as directed until the desired qualities are obtained.

Every precaution shall be observed to ensure that the manufacture and placing of concrete in the works is carried out in the same fashion as that used in the manufacture of the selected trial mix.

The Project Manager may direct that fresh trial mixes be made should there be any change in the source or grading of the aggregate, manner of making and compacting, or other change from the trial mix adopted originally.

The crushing strength of “preliminary” test cubes taken from trial mixes, shall at 28 days be not less than 25% more than that specified for the minimum crushing strength of “Works” test cubes as later described, for the same quality of concrete.

Concrete cubes shall be submitted to the Project Manager for “Preliminary” and “Work” Cube Tests. The Contractor shall equip himself with accurately made metal moulds for casting 100mm square concrete cubes.

The moulds and method of preparing such cubes shall be in accordance with B.S 1881 “Method of Testing Concrete”.

Batches of six “Preliminary” cubes shall be taken from the trial mixes as previously described. Six “Work” cubes shall be taken for testing from any batch or class of concrete in use on the works as directed by the Project Manager.

Three cubes shall be tested at 7 days and three at 28 days.

All concrete cubes when tested shall give the minimum compressive strengths for the appropriate class of concrete shown in the following table:-

**Table 4.12.1: Compressive strength and modulus of elasticity of concrete (N/mm<sup>2</sup>)**

Grade	Characteristic compressive strength at 28 days (N/mm <sup>2</sup> )		Cube strength (N/mm <sup>2</sup> )		Characteristic tensile strength at 28 days (N/mm <sup>2</sup> )	Modulus of elasticity at 28 days (N/mm <sup>2</sup> )
	28days	7days	28days	7days		
15	15	12	18	14.4	1.1	25x10 <sup>3</sup>
20	20	16	24	19.2	1.3	27x10 <sup>3</sup>
25	25	20	30	24	1.5	29x10 <sup>3</sup>
30	30	24	36	28.8	1.7	32x10 <sup>3</sup>
40	40	32	48	38.4	2.1	35x10 <sup>3</sup>
50	50	40	60	48	2.5	37x10 <sup>3</sup>

Concrete test cubes shall be submitted to the Central Materials Laboratory, Kampala, for testing and the Contractor shall carefully identify each cube and provide all information relative thereto, e.g. contract number, mix proportions, date cast, where the rest of the batch has been incorporated in the works and the Contractor's name and test cube reference number.

In the event that any cubes representative of concrete which has already been incorporated in the work failing to give the required compressive strength, the Project Manager reserves the right to instruct the contractor to cut out and remove all work affected by these cubes and replace it entirely at his own expense.

### 4.13 Mixing of Concrete

Concrete shall be thoroughly mixed to a uniform consistency in measured batches in a mechanical mixer of capacity proportionate to the amount of concrete required in any section of the works under construction. Mixing shall continue for not less than two minutes after all the materials including water, which shall be added last of all, have been passed into the drum and before

any portion of the batch is discharged but in all cases the actual shall conform to that required for the selected trail mix.

The water content shall be carefully controlled and shall be added in sufficient quantity to make up the amount found to be necessary in the trial mix under no circumstances will the water; cement ratio be exceeded and any batch which is mixed too wet shall be rejected. The entire contents of the mixer drum shall be discharged before the succeeding batch is introduced into the drum.

Mixers and or batching plant shall be properly maintained throughout the contract and any mixer of plant which is faulty in any respect shall not be used. Drums of all mixers shall revolve at a constant speed recommended by the manufacturers. A mixer which has been standing idle for twenty minutes after mixing the last batch shall be thoroughly washed and cleaned before any fresh mix is made. Mixers shall be thoroughly cleaned at the finish of each run of concrete mixing or at the end of each day. All mixing plant shall be thoroughly cleaned if used for High Aluminium or other specialised cement concretes after Common Cement concretes and vice-versa.

#### **4.14 Hand Mixing**

Hand mixing shall only be allowed with the express permission of the Project Manager.

The mixing shall be done on a clean, watertight, non-absorbent platform. The cement and fine aggregate shall be mixed dry until the mixture is thoroughly blended and uniform in colour. The coarse aggregate shall then be added and mixed in until it is uniformly distributed throughout the batch. The correct quantity of water shall be added using a can with a rose nozzle and the mixing continued until the entire batch of concrete appears to be homogenous and has the desired consistency. Each batch of concrete shall be turned over at least three times dry and three times wet.

The platform shall be emptied before a subsequent batch is mixed and thoroughly cleaned if not in use for more than 20 minutes before the next batch is prepared or if a different type of cement is used as previously described.

For hand mixing the cement content of each mix shall be increased by 10% over that required for machine mixing and this shall be done at the Contractor's own expense.

#### **4.15 Transporting and Placing Concrete**

Concrete shall be transported in a manner which will avoid any segregation, loss consolidation or drying out of the consistent materials and placing in the forms shall be completed before the initial set takes place. Concrete shall not be dropped through a height greater than 2m. Chutes and pumps may be used provided they shall be so arranged as to avoid segregation.

All equipment for the transporting and placing of concrete shall be constantly cleaned and kept free of all coatings of hardened concrete or other obstructions.

Concreting of any unit or section of the work shall be carried out in one continuous operation and no interruption of the concrete will be allowed without the approval of the Project Manager.



In no case shall more than 20 minutes elapse between mixing and placing of any concrete in its final position.

#### **4.16 Ready Mix Concrete**

The term "Ready Mix" concrete is applied in cases where concrete is obtained from a firm which specializes in the manufacture of concrete in bulk at a central plant whence it is transported to the site in transit mixers which keep it agitated until it is delivered. This term also applied to concrete in which the aggregate and cement are batched dry at a central plant and fed into the drum of a mixer mounted on a lorry in which it is transported to the site. Water is carried in a special container and is measured and fed into the drum and wet mixing started, either during the journey or when the mixer lorry reaches the site.

This type of concrete will only be allowed on the specific instructions of the Project Manager who will require a certificate with every batch of concrete delivered giving the actual weights of aggregate, cement and water used so that a guarantee is provided that the concrete is in accordance with the Specifications.

#### **4.17 Compaction of Concrete**

After concrete has been placed in the forms it shall be compacted with approved tools and in such a manner as to produce a dense homogenous mass, free from segregation honeycombs and entrained air, filling all spaces between and around forms and reinforcement without voids of any kinds.

Where vibrators are used they shall be of the immersion type, approved by the Project Manager and have a frequency of not less than 5000 hertz (HZ). Vibrators shall not be attached to or allowed to come into contact with reinforcement or used in such a manner as to damage concrete in other parts of the structure, which has taken its initial set. Care is also to be taken so that concrete is not over vibrated or compacted and segregation taken place.

Partially set concrete shall not be disturbed in any way and the Contractor shall ensure that it is not subjected to unnecessary loads, shocks or vibrations from adjacent plant or vibrators in the vicinity nor allow his workmen to walk on it or disturb it in any other way.

#### **4.18 Construction Joints**

Construction joints shall be made where shown on the drawings or as directed by the Project Manager, but in either case they shall be so arranged that their number is kept to the minimum.

Construction joints shall be formed at right angles to the axis of the member concerned by the insertion of rigid stopping off forms.

Construction joints in slabs shall be vertical and in general, parallel to the main reinforcement, but, when required at right angles to the main reinforcement they shall be constructed in the middle of the span.

The upper surface of lifts of concrete in walls and columns shall be horizontal and in the case of exposed finished work shall be so constructed so that they cannot be seen.

Lifts in walls and columns shall not exceed a height of 1m unless approved otherwise by the Project Manager.

Forms at construction joints shall be so made that they shall produce within the thickness of the joint a suitably grooved or keyed surface to act as a bond for the subsequent concrete.

As soon as the concrete is sufficiently set stop boards shall be removed and the face hacked and wire brushed to form a key and washed. Before placing of the adjacent concrete the surface of the joint is to be coated with a neat cement grout and left ready to receive the new adjacent concrete which is to be tightly packed up against its face.

Construction joints shall be located so as not to impair the strength of the concrete. The position of construction joints and the size of the formwork panels shall be so co-ordinated that where possible the line of any construction joint coincides with the line of a formwork joint and that in any case all construction joint lines and formwork joint lines appear as a regular and uniform series. For all exposed horizontal joints and purposely inclined joints, a uniform joint shall be formed with a batten of approved dimensions to give a straight and neat joint line. Concrete placed to form the face of a construction joint shall have all laitance removed and the large aggregate exposed prior to the placing of fresh concrete. The laitance shall wherever practicable be removed when the concrete has set but not hardened by spraying the concrete surface with water under pressure or brushing with a wire brush sufficient to remove the outer mortar skin and expose the large aggregate without disturbing it. Where the laitance cannot be removed due to hardening of the concrete, the whole of the concrete surface forming the joint shall be treated by high pressure water jet, sand blasting, use of a needle gun or a scaling hammer to remove the surface laitance.

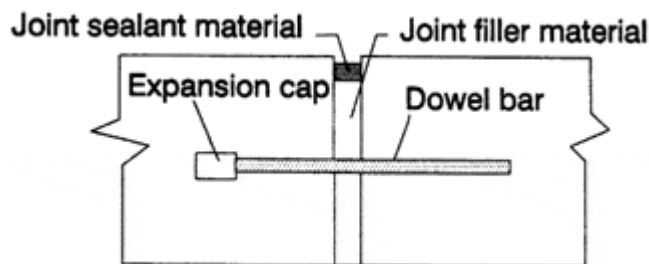
The other alternative but effective method is:

- Apply retarder by brush on the concrete surface and wash it by water jet. The laitance at top does not get set and is easily removed by washing. Before concreting is resumed, all loose matter on the existing concrete surface shall be removed by compressed air and the surface slightly wetted, but excess water removed by soaking or air jet (Never spray cement slurry).

Concrete shall not be allowed to run to a feather-edge and any vertical joints shall be formed against a stop-end. If a kicker or stub-end is used it shall be at least 70 mm high. Removal of laitance from vertical face, wetting etc. shall be same as for horizontal joint as explained above. No concreting shall be started until the positions and form of the construction joints (both horizontal & vertical) are inspected and found in order.

#### **4.19 Movement /Expansion Joints**

Movement joints are defined as all joints intended to accommodate relative movement between adjoining parts of a structure, special provision being made where necessary for maintaining the water tightness of the joint. The contractor shall pay due regard to the instructions of manufacturers of proprietary jointing materials and shall, if required by the Engineer, demonstrate that the jointing materials can be applied satisfactorily.



**Fig: Expansion joint in concrete**

As far as possible, jointing of waterstops on Site shall be confined to the making of butt joints in straight runs. Where it is necessary for an intersection, or change of direction, or any joint other than a butt joint in a straight run, to be made on Site, a preliminary joint, intersection or change of direction piece shall be made and submitted to such tests as the Engineer may require. Flexible waterstops shall be fully supported in the formwork, free of nails and clear of reinforcement and other fixtures. Any waterstops which after installation is found to be damaged shall be removed and replaced. Concreting in the vicinity of waterstops shall be carried out with care to ensure that the waterstops do not bend or distort while the concrete is being placed and compacted in position. The surface of set concrete in a movement joint shall, where specified on the drawing, be painted two coats of bituminous paint and new concrete shall be placed against it only when the paint is dry. Expansion joints shall be formed by a separating strip of approved preformed joint filler.

Caulking grooves shall be provided as shown on the Drawings. At all joints where a caulking groove is formed, the groove shall be wire brushed and loose material removed and blown out by compressed air immediately prior to caulking. After the groove has dried, it shall be primed and caulked with approved jointing compound. At all caulked joints, the face of the caulking strip and 50 mm width of concrete on either side shall be painted with two coats of paint having the same base as the caulking compound.

#### **4.20 Protection of Concrete**

Freshly placed concrete shall be protected from the sun, drying winds and rain until it has properly set and shall be kept damp with hessian, sand, polythene or other waterproof sheeting for not less than seven days after laying. In the case of rapid hardening cements being employed this shall be reduced to three days.

Concrete which has not been properly protected and is damaged or adversely affected in any way whatsoever shall be carefully cut out and replaced at the Contractor's own expense.

#### **4.21 Concrete Surface Finishes**

The surface of all concrete foundation beds shall be finished to a level even surface to receive the walling.

The upper surface of floors, roofs, landings etc. shall either be trowelled smooth or where they are to be covered with screeds for other finishes shall be floated while onset to a smooth even finish free of all projection and irregularities either level or to falls as shown on the drawings.

The trowelling and floating shall be done in such a manner that the surface is free of laitance or cement slurry. After the removal of formwork, all surfaces in

contact with same shall be drenched with water, and carefully rubbed down with a carborundum block to remove fins and other irregularities. Any honeycombing or other damaged surface shall be carefully filled up with neat cement slurry and rubbed down to finish flush with the surrounding work. Such work shall be prevented from drying too rapidly by the use of damp sacking or similar means to ensure a good key between the concrete and the grout.

When the concrete surfaces are to be left exposed, the required surface finish shall be specifically stated in either the Particular Specification or the Bills of Quantities.

No rubbing down, repairing or patching of concrete shall be carried out until the surfaces have been inspected by the Project Manager.

#### **4.22 Fair Face and Fine Face Finishes of Concrete**

When exposed concrete is required to have a "Fair Faced Finish" it means that it is to be finished to a perfectly plane smooth surface free from all blemishes, irregularities, honeycombing, joint or grain marks.

The manner of obtaining this type of finish will be left to the discretion of the Contractor but the Project Manager reserves the right to instruct the Contractor to adopt an alternative method where he thinks the method in use is unsatisfactory.

Where "Fine Face" concrete finish is specified, the exposed surfaces where produced by formwork shall have all fins and other small protuberances rubbed down but no pinnacles nor large fins or other protuberances will be allowed. The face of the concrete shall be finished perfectly smooth and even.

#### **4.23 Form HoleChases**

Form all holes, pockets, chases, etc. required for services and other fittings as indicated on the drawings or otherwise by the use of liners, sleeves, cardboard tubes, temporary boxings and timber fillets attached to the framework.

Holes and chases shall not be cut in structural concrete after it has set except on the specific instructions of the Project Manager.

#### **4.24 Steel Reinforcement**

Steel reinforcement shall conform to BS 4449, BS 4492 or BS 4483.

Mild steel reinforcement shall consist of plain round mild steel rods as specified in BS 6722.

Twisted mild steel reinforcement shall be cold twisted mild steel reinforcement as specified in BS 449.

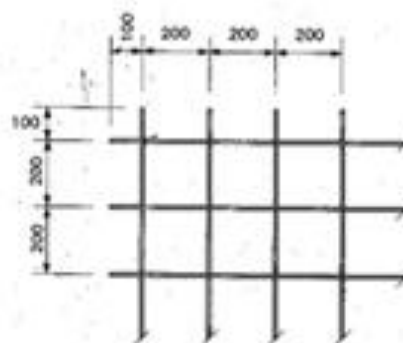
Fabric reinforcement shall be hard drawn steel fabric reinforcement in accordance with BS4483:2005 "Steel fabric for the reinforcement of concrete". The Stock size of standard meshes is 4.8m x 2.4m.

If a unit is larger than a stock sheet, then lapping will be necessary. Lapping requirements for two sheets of mesh is covered by BS8110 cl 3.12.8.5. If the

lap occurs at the middle of a panel, then the minimum lap length for an 'A' mesh must include 4 welded cross wires. This infers a minimum lap length of  $(3 @ 200 + 100) = 700\text{mm}$ . Care should be taken at laps since the overall space required for several sheets could become excessive. If the quantity merits it, consideration should be given to special sheets, (see below for detailing rules.)

An alternative to lapping sheets of mesh may be to 'lap' using loose bars. In this case the lap length will be determined by the standard 'rules' based on bar diameters.

*"A" Square Mesh Fabric*  
A 200mm square mesh with longitudinal wires and cross wires of the same size.



The normal edge detail for 'A' mesh sheets is as shown left. If the sheet is cut then the overhang may be even higher, up to nearly 200mm. In these cases, if this occurs at a face of the concrete, a loose edge-trimming bar should be added to the end of the cross wires with (typically) 50mm cover. The diameter of this trimming bar should be as the adjacent wire.

All steel reinforcement shall be of approved manufacture and shall be free from loose rust, mill scale, oil and grease or any other material which may impair the proper adhesion of the reinforcement and the concrete or cause corrosion of the reinforcement and subsequent disintegration of the concrete cover. If directed by the Project Manager, all the reinforcement shall be wire brushed to remove such imperfections before concrete is poured around it.

The Contractor shall produce Certificates of Manufacture indicating that the material complies with the requirement of the appropriate B.S. or UNBS standards for the inspection of the Project Manager. Random samples from any consignment may be taken for testing at the Central Materials Laboratory of the Ministry responsible for Works and any material found to be brittle, cracked or unsatisfactory in any way whatsoever shall be rejected and removed from the site at once.

Reinforcement shall be stored on site in level tiers raised above the ground.

#### 4.25 Bending Reinforcement

All steel reinforcement shall be bent cold and shaped as shown on the drawings before placing in position and shall comply with the bending dimensions and tolerance laid down in BS 8666 or BS 4466

An approved former shall be used to produce gradual and even bending and no steel shall, once, bent, be straightened and rebent.

Bends made whilst the reinforcement is hot or welding either by gas or electricity shall not be carried out without the prior approval of the Project Manager.

#### **4.26 Spacing of RC bars**

The spacing of bars, amount of reinforcement and the type of fabric, mesh size, disposition, etc. shall be in accordance with the drawings and bending schedules.

#### **4.27 Fixing and Assembly of Reinforcement**

All reinforcement shall be accurately placed, fixed and maintained in the positions shown on the drawings. Intersecting bars shall be securely wired together with No. 16 gauge (1.626 mm) soft iron tying wired with the ends twisted and turned into the body of the concrete. Binders, links and the like shall make close contact with main reinforcement and shall be securely wired to same.

When reinforcement is placed in horizontal or sloping layers whether in beams, slabs or staircases, etc., the distance between each layer shall be carefully maintained by the insertion of sufficient spacer bars to prevent either movement or sagging of the main reinforcement in each layer.

#### **4.28 Cover to Concrete**

The concrete cover to all reinforcement shall be carefully maintained as shown on the drawings and bending schedules within a tolerance of 3 mm under or over.

Cover to underside of soffits may be obtained by the use of accurately made cement mortar blocks.

#### **4.29 Inspection of Reinforcement**

No concrete shall be poured until the Project Manager has inspected and approved the reinforcement.

All reinforcement shall be properly fixed in position and every precaution shall be taken to ensure that no movement takes place whilst the concrete is being poured and compacted and that it is properly surrounded by concrete.

Any rods which have worked loose during fixing shall be securely retied and any small pieces of rod or fabric shall be removed from the forms before pouring is commenced.

#### **4.30 Formwork**

The term formwork shall include for any material or mould required for forming the concrete into the desired shape and upholding it until it is set, together with all necessary temporary supports, stagings, bolts, nuts, wedges, clamps, and other fixing, all cutting and waste and the cost of all labour and material in the construction, erection and removal of such formwork.

Formwork shall be of timber or other approved material and shall be of such strength as will ensure complete rigidity throughout the placing, compaction, vibration and setting of the concrete and so designed and constructed that it

can be easily removed without shock, vibration or damage to the finished concrete.

All joints in forms shall be sufficiently tight to prevent leakage of grout and in timber forms, unless otherwise specified, they shall be tongued and grooved.

Timber boards for formwork shall be seasoned to 20% moisture content and shall be in widths not exceeding 150 mm or narrower if the Project Manager so directs.

The use of internal ties shall be avoided as far as possible, but, if used they shall be reduced to the minimum, of metal and capable of easy removal without damage to the face of the concrete. No part of any metal tie or spacer remaining permanently embedded in the concrete shall be nearer the finished surface of the concrete than the thickness of the general cover dimension as shown on the drawings.

When vibrators are used, special care shall be taken to see that all bolts, wedges, clamps, etc. are kept tight so that no distortion of the forms takes place.

#### **4.31 Formwork Non-Exposed Concrete**

When the surface of the concrete is to be covered with some other finishing material, the forms may be constructed of plain, but jointed sawn timber, unless otherwise instructed by the Project Manager. The boards shall be sufficiently thick to withstand the loading of the concreting operations without deflection so that the finished surface cover specified is maintained.

#### **4.32 Formwork for Exposed Concrete**

When a particular type of finish is required to be produced by formwork on exposed concrete surfaces this will be fully described in the Particular Specifications or Bills of Quantities, and the material to be used to achieve it will be specified, i.e. plywood, hardboard, hessian, polythene paper, strips, panels, etc.

When wrot formwork is required the boards shall be tongued and grooved and wrot and free from all cracks and irregularities on the face in contact with the concrete.

#### **4.33 Preparation of Formwork before Concreting**

Unless otherwise directed the inside faces of all formwork shall be coated with lime wash or an approved non-retarding mould oil. Care shall be taken to keep reinforcement free of any coating material.

Temporary windows shall be cut in the sides of vertical surfaces of forms to ensure that concrete is not poured from a height exceeding 1.5 m.

Forms shall be thoroughly scraped and cleaned down between each and before subsequent uses.

Prior to depositing concrete, the forms shall be thoroughly cleaned and freed from all sawdust shavings, mud, dust or other debris by hosing with clean water and draining through temporary openings left for this purpose.

### 4.34 Approval of Formwork

All formwork shall be inspected and approved by the Project Manager before pouring of concrete. Forms is commenced, but such approval will not relieve the contractor of his overall responsibility for the safety and efficiency of the works. Details of special forms and systems of formwork i.e. self lifting or sliding forms etc. shall be submitted to the Project Manager for his approval before they are put into use.

### 4.35 Removal of Formwork

The removal or striking of formwork shall be carried out in such a manner that the concrete will not be subjected to sudden shock or injury, nor shall it be removed before the concrete is sufficiently set hardened.

The minimum time shall elapse between placing and compaction of the concrete and the removal of the formwork for various parts of the structure is indicated in the following table:-

**Table 4.34.1: Minimum Times for Removing Formwork**

Location	Removal of Forms Only	Removal of Props
Side of beams, Walls and columns	4 days	-
Soffit of Main Slabs	12 days	28 days
Soffit of Secondary Slabs	6 days	24 days
Soffit of Beams	12 days	28 days

The foregoing figures are given as a guide for normal cement concrete for average conditions of setting and hardening. For vibrated concrete or extreme climatic conditions or for special surface finishes the above times may be varied on the instructions of the Project Manager.

Compliance with the requirements of the foregoing shall not relieve the Contractor of his obligations and overall responsibility. Should the removal of the formwork be found to have been carried out prematurely, any damage caused thereby shall be made good entirely at the contractor's own expense.

### 4.36. Composite Concrete/HollowClay Block Structures

Composite concrete/hollow clay block construction when specified for floors and roofs shall consist of 305 x 305 mm hollow clay filler blocks placed end to end in rows on formwork as described with an in-situ reinforced concrete rib between each row and a concrete topping or cover over the blocks. The overall thickness of the composite slab, thickness of the filler blocks and the width of the ribs and details of reinforcement and concrete mixes in the ribs and topping will be described in the Particular specification or bills of Quantities.

All hollow clay filler blocks shall be well burnt, of even colour, uniform density free from cracks, distortion and conforming in every respect with the requirements of BS 3921 Part 2.

The hollow clay blocks shall be laid end to end in rows, care being taken that the joints are close and that the specified width between rows is maintained. Ends of rows of blocks shall be plugged with a stiff mixture of cement and sand 1:3 before the inset concrete is placed.



The ribs and transverse reinforcement as specified is then to be fixed in position, care being taken to ensure that the filler blocks in each row are not displaced.

Concrete as specified is to be placed in the ribs and topping and compacted as described, care again being taken to see that the reinforcement and filler blocks are not displaced. The topping is to be leveled and smoothed over to receive the finish as specified and carefully covered up and protected as before described for solid reinforced concrete slabs.

Before the placing of the concrete ribs and topping is commenced the spaces between the rows of blocks shall be thoroughly cleaned of any rubbish and the clay blocks and formwork sprayed with clean water.

The contractor shall provide this construction only to the extent indicated on the drawings, any other areas from where this work stops up to the outer edges of the construction being made out with thickness equal to the thickness of the composite slab.

The minimum time for removal of formwork given in Table 6 will apply for this type of construction.

#### **4.37 “Freespan” and “Maxspan” Suspended Structures**

The burnt clay beam, rib and filler tiles for “Free span” and “Maxspan” construction or their equivalent shall, be by approved manufacturers.

“Freespan” is a system of clay blocks, concrete and reinforcement assembled into precast beams whilst “Maxspan” uses a system of clay ribs, and reinforcement assembled into precast ribs with hollow filler blocks between and inset concrete rib filling and topping.

All clay blocks shall be as previously specified and any which are cracked, chipped, broken or distorted shall be rejected.

Concrete for filling beams, ribs and topping is to be Mix “C” 12 mm aggregate as described.

Steel reinforcement shall be as previously specified bent or hooked at ends required and accurately and securely positioned in the units.

All units shall bear on perimeter walls or supports a minimum of 115 mm.

The units shall be assembled for precasting on an even, clean concrete bed or timber form provided with a camber of approximately 1/300 of the span.

The precasting of beams and ribs is to be carried out under cover. The units shall be kept covered with wet hessian or other approved means and left to cure for a minimum period of 14 days during which time the hessian etc. shall be kept wet.

When the units are cured and ready for handling they shall be carefully removed from the place where they were cast without undue shock or jarring and transported and hoisted into position where required. Each unit must be handled at each end to ensure that cracking does not take place. When fixed in position the joints between adjacent beams shall not exceed 3 mm.

After placing in position, the ends of all hollow blocks and beams shall be sealed with a stiff mixture of cement and sand (1:3).

Carefully cover up and protect the finished surfaces of all "Freespan" and "Maxspan" slabs as previously described for concrete work.

#### **4.38 "Freespan" Units or Beams**

The "Freespan" burnt clay blocks 305 mm wide and 30mm long shall be closely assembled end to end in straight lines on the casting bed to form beams of the required length. The required amount of reinforcement is then placed in the channel, after which the blocks are soaked thoroughly with water and filled with concrete, properly compacted as described.

After curing as before described the units shall be hoisted and fixed in position side by side, the recessed side joints flushed up with cement and sand (1:3) and the whole covered with a layer of fine concrete or cement and sand (1:3) not less than 20 mm thick or as otherwise specified, finished to a level even surface.

#### **4.39 "Maxspan" Precast Rib and Filler Block Structures**

The "Maxspan" clay rib channel blocks either 75 or 100 mm wide as specified shall be assembled to form rib units as described for "Freespan" beams.

The rib channels are then thoroughly soaked with clean water and four 6 mm diameter mild steel rods inserted into the prepared grooves in the blocks and grouted in place with a stiff mixture of cement and sand (1:3). These units can be precast one on top of the other up to a maximum of 10 in height.

After curing the ribs shall be hoisted and described of the diameters shown in the fixed in position at the appropriate centers following table:-and propped on the underside every 2 m. The hollow filler blocks of the specified size shall be laid end to end between the rib units.

Reinforcement of the specified size is then laid in the rib channel and the transverse distribution reinforcement placed in the topping. The whole of the ribs and filler blocks shall be thoroughly soaked with clean water and the ribs and topping filled up to the specified thickness with well compacted concrete Mix "C" 12 mm aggregate all as previously described. Finish surface level and even ready to receive screeds.

#### **4.40 Concrete Lintels**

Concrete in lintels to be (1:2:4) as previously described, well tamped around reinforcing rods. The reinforcement and sizes of lintels shall be in accordance with drawings for standard Lintels, copies of which can be obtained from the Project Manager unless otherwise directed by the Project Manager.

Lintels may be cast in-situ or precast. When cast in-situ the general concrete specifications already described shall apply except that the lintel may be built upon after 7 days providing the soffit boards and propping are not removed.

Precast lintels shall be cast in accordance with the clauses governing precast concrete as later described but they shall not be built on for a minimum of 14 days after casting or such other longer period as the Project Manager may direct.

Provide to all buildings where shown on the drawings as an in-situ concrete (1:2:3) ring beam 225 mm deep for the full thickness of the wall, cast in alternate 6 m lengths, with suitable construction joints and reinforced with 4 No. 12 mm diameter twisted steel reinforcing rods with 6 mm diameter stirrups at 300 mm centers.

Unless otherwise indicated on the drawings or other Contract Documents, lintels shall be of the depths and bearings and reinforced with round mild steel reinforcement as described of the diameters shown in the following table:-

Table 4.39.1 – Concrete Lintels for Normal Spans and Loading

Clear span (mm)	Bearing Each End (mm)	Depth (mm)	Diameter of Reinforcement in mm per 115 m thickness of wall
up to 610	115	100	1
610 to 1000	115	150	10
1000 to 1300	115	150	10
1300 to 1600	230	230	12
1600 to 1900	230	230	12
1900 to 2500	230	230	12
2200 to 2500	230	230	16
250 onwards	As	indicated	on drawings

All reinforcement in lintels shall be embedded in the concrete to have not more than 40 mm cover on the soffit, and ends of bars shall be hooked.

Where shown cills shall be of rebated, splayed and throated precast concrete to the sizes required and having an outer projection of not less than 40 mm from the finished wall face. They shall be cast in suitable moulds and finished fine on all exposed faces, free from all cracks, crazing, chipped or broken arises, discolouration or other defects.

Reinforcement shall be provided where necessary for handling with a 25 mm minimum cover.

Cills over 1.4 m Long shall be divided into even sections, and butt jointed with joints not more than 1/8' thick grouted up with cement mortar and neatly flush pointed.

Clean cut throatings 12 mm deep shall be formed 25 mm back from the finished outer edge of the cill.

Stoolings not less than 50 mm wide shall be formed on cills required to be built in.

Cills to take metal windows shall have holes for fixing lugs formed during casting to the required size, depth and positions.

All concrete not plastered shall be finished fair face unless otherwise stated. Unless otherwise state precast concrete ventilators to be 300 mm or 225 mm wide x 225 mm x 40 mm thick of approved pattern. The ventilators shall be fixed double, one fixed flush with outer face of wall and having approved copper mosquito gauze cut to size and fixed by tucking over top and bottom edges of ventilator before building in, the other ventilator fixed flush with inner face of wall and include for rendering around sides, top and bottom of ventilator opening in cement and sand (1:4).

All concrete floors shall be in concrete (1:3:6) and have a minimum thickness of 100 mm unless otherwise shown on drawings.

Entrance steps as required to suit ground and floor levels shall be formed in concrete (1:3:6), with suitable foundations under as directed by the Project Manager. Treads shall be not less than 300 mm wide and risers not more than 175 mm high. All exposed surfaces shall be finished in cement and sand (1:4) trowel led smooth with a wood float 20 mm thick on treads and 12 mm thick on risers or finished with carborundum dust.

All suspended precast or in situ concrete shelves, pot slabs, etc., shall be reinforced with B.R.C. Weld mesh No. 28 or 210 as ordered by the Project Manager or other equal and approved fabric reinforcement. Where required these shall be size 600 mm x 600 mm x 50 mm thick of vibrated (1:2:4) concrete finished on top with a wood float, clean cut edges and free from all cracks, chips or broken corners. The slabs shall be laid on a 75 mm consolidated bed of sand or stone dust, laid to falls where necessary and jointed and pointed in cement mortar (1:4). The jointing mortar to be worked well down into the joints and the pointing to be key drawn and all excess mortar cleaned off.

#### 4.40 Precast Concrete

All precast concrete work shall be carried out in accordance with the instructions of the Project Manager and as recommended by the Code of Practice BS 8110 except that, where the Code differs with these specifications, these specifications shall take precedence.

The concrete and reinforcement shall be as described elsewhere or as indicated on the drawings.

The moulds for precast work shall be of stout timber or steel, strong, properly made true to shape to produce the sections shown on the drawings, finished perfectly true, without twist or deformation of any kind and having clean sharp arises, grooves, sinkings, etc., as required.

When concrete is specified as with "Fair Face Finish" the moulds shall be lined with a smooth surface free from all blemishes, irregularities, honeycombing, joint or gain marks.

Where the concrete is described as "Finished Fine" the moulds shall be made of metal or are to have linings which will produce a smooth dense fine face to the finished concrete free from all shutter marks, protuberances and pittings and suitable to receive a painted surface direct.

Concrete shall be thoroughly tamped in the moulds and if required by the Project Manager shall be vibrated as described.

The precasting shall be carried out under an approved shade and shall remain under same for a minimum period of seven days after which the moulds may be removed and the units stored under shade for a further seven days.

After this the units may be stacked in the open for not less than seven days before fixing. Unless otherwise described, faces shall be left rough from the sawn moulds.

For the whole of the period from casting of the units until the time they are put into use they shall be covered with sacking or approved material which is to be kept wet constantly.

All units shall be cast in convenient lengths for handling and the contractor shall provide all necessary handling reinforcement whether specifically shown on the drawings or not.

#### 4.41 Concrete Apron

To all houses of Category D and above and where directed by the Project

Manager, the contractor shall provide a 50 mm C 15 concrete apron, 1 m wide around the perimeter of the building, laid on a 100 mm bed of hardcore.

#### **4.42 Attendance**

Particular care shall be exercised by the contractor to ensure that all pipes, ducts, drains, conduit, junction boxes, anti-static installations, etc are laid before the concrete for the floor and roof slabs is poured, and the Contractor will be held responsible for the cost of any additional cutting etc. and making good which becomes necessary through his failure to make proper arrangements for all sub-contractors work to be done in close cooperation with his own.

## **5.0 WALLING**

### **5.1 General Requirements**

#### **5.1.1 Cement**

The cement used shall be as described in "Concrete Work".

#### **5.1.2 Lime**

The lime shall be best quality hydrated lime from an approved source and shall conform to BS EN 459-1:2001 or the equivalent UNBS Standard.

#### **5.1.3 Sand**

Sand for mortars shall be as described in "Concrete Works" except that it shall be fine sand.

#### **5.1.4 Mortars**

The cement mortar shall consist of one part of cement to four parts of sand by volume (1:4). The sand shall be measured in specifically prepared gauge boxes and thoroughly mixed in an approved mechanical mixer or mixed dry on clean and approved mixing platforms, with water added afterwards until all parts are completely incorporated and brought to a proper consistency. The use of retempering of wholly or partially set mortar will not be allowed.

The gauged mortar shall consist of one part of cement to two parts of lime to nine parts of sand by volume (1: 2: 9).

In the case of gauged mortar, the sand and lime shall first be mixed into a coarse mix before addition of cement. All mortar is to be thoroughly mixed to a uniform consistency with only sufficient water to obtain a plastic condition suitable for toweling. No mortar that has commenced to set is to be used or knocked up again for reuse.

#### **5.1.5 Protection**

All walling shall be properly protected while the mortar is setting as the Project Manager shall direct.

#### **5.1.6. Setting Out**

The Contractor shall provide proper setting out rods and set out on the same all work showing opening, heights, cills and lintels and shall build the various walls and piers to the thickness, widths and heights shown upon the drawings. No part of the walling shall be carried up more than 900 mm higher at one time than any other part and in such cases the joining shall be made in long stops so as to prevent cracks arising and all walls shall be leveled round at each floor and roof level.

## 5.2 Brick Walling

### 5.2.1 Bricks

Bricks shall be kiln burnt bricks from a local source, and samples shall be submitted for the Project Manager's approval. Bricks are to comply with BS EN 772 and BS 6750 as regards size and tolerances, and shall be of good shape, well burnt, of even colour, free from flaws, stones and unburnt lumps and are to emit a clear ringing sound when struck one another. Brittle or badly burnt bricks must not be used and broken bricks or bats may only be used where required for bond. No brick shall absorb more than 20% of its dry weight during 24 hours immersion in water.

Load bearing brickwork shall be constructed in solid bricks and internal non-load bearing walls where specified may be built in bricks having perforations.

Clay bricks for load-bearing construction shall be as manufactured by Uganda Clays limited or any other approved source. The properties of the bricks shall be as shown in Table 5.2.1.1

Bricks may also be used in non-load bearing construction as facing or in-fill walling. The various classes of bricks are: -

- (a) Non-facing plastered (NFP);
- (b) Facing brick standard (FBS);
- (c) Facing bricks aesthetic (FBA); and
- (d) Engineering brick (EB)

**Table 5.2.1.1: Physical Properties of Bricks**

Class of Brick	Crushing Strength (N/mm <sup>2</sup> )	Water Absorption	Average Weight (kg)
NFP	10	10	2.75
FBS	20	6.3	2.75
FBA	22	7.5	2.75
EB	25	7.9	3.00

### 5.2.2 Facing Bricks

The facing bricks unless otherwise described shall be bricks specially selected from the common stock for evenness of size shape and colour.

Care is to be taken when selecting and stacking facing bricks to see that all bricks with chipped or damaged faces or arises are rejected.

Facing bricks shall be obtained from an approved manufacturer and conform with BS EN 772 and samples shall be submitted for the Project Manager's approval. Purpose made corner blocks and half blocks shall be used as necessary at angles etc., and for purposes of bond.



### 5.2.3 Concrete Blocks

Concrete blocks shall be machine made, solid or hollow as specified, and comply with BS 6073, work other than internal non-load bearing partitions which may be of blocks in accordance with Type C.

Blocks shall be made with naturally occurring aggregates complying with BS EN 1260 with a binder as listed in BS 4887 except that lime as a sole bind agent will not be allowed.

The density of Type 'A' blocks shall be not less than 1500 kg/m<sup>3</sup> and the density of type C may be less than this providing it meets the due requirements regarding strength.

The choice of a suitable mix to produce blocks of the required properties will be left to the discretion of the Contractor but all blocks shall have compressive strengths in accordance with the following Table:-

**Table 5.2.3.1: Minimum Compressive Strength of Concrete Blocks**

Block	Minimum Compressive Strength	
	Average of 10 Blocks N/mm <sup>2</sup>	Individual Block N/mm <sup>2</sup>
1	3.5	2.8
2	2.8	2.2

As a guide a mix consisting of one part cement, two parts of fine aggregate grade 9mm down but free of fines and dust and seven parts of coarse sand by volume (1:2:7) will produce a block of the required strength but this must not be regarded as infallible and the contractor will be entirely responsible for finding the most suitable mix consistent with the available aggregates which will produce blocks of the requisite properties and strengths.

If suitable materials are not obtainable locally the Contractor shall obtain them from such other sources as he carried out under shelter and after casting the blocks shall be stacked under shelter to protect them from sun and adverse weather. The blocks shall be properly cured by covering them with sand or sacks and spraying daily for not less than 14 days.

All blocks must be left with good sharp edges. The standard face size of blocks for use in the Works shall be 450 x 225 mm and these size blocks shall be used wherever, practicable. Proper bonding shall be formed at corners, round openings, cills, lintels, beams, etc., and similar positions and the Contractor must make or cut blocks to all varying sizes required for these purposes.

Should the Contractor obtain blocks from local manufacturers or suppliers he shall be responsible for ensuring that the blocks are of such quality as to meet the above loading requirements.

### 5.2.4 Fair-faced Blocks

Concrete blocks for fair faced walls shall have a perfectly smooth exposed face free of all honeycombing, blemish or other irregularity.

### 5.2.5 Stone

Stone shall be obtained from a local source and samples shall be submitted for the Project Manager's approval.

It is to be free from cracks, fissures, sand and clay holes and is to be dressed to shape on the beds and faces as described in the Particular Specification or as indicated on the Drawings.

### 5.2.6 Bond and Joints

All brickwork shall be built in English bond except that half brick walls shall be built in Stretcher bond.

All block work shall be properly bonded together and in such a manner that no vertical joint in anyone course shall be within 225 mm of a similar joint in the courses immediately above and below. Alternate courses of walling at all angles and intersections shall be carried through the full thickness of the adjoining walls.

All prebends, reveals, quoins and other angles of the walls shall be built strictly true and square.

### 5.2.7 Cleaning Facework

All bricks and blocks shall be well wetted before use and tops of walls where left off shall be well wetted before commencing building. All joints shall be flushed up and grouted in solid as the work proceeds.

### 5.2.8 Plaster Key

Joints shall not exceed 9 mm or as otherwise indicated on the Drawings.

All faced brickwork and block work is to be kept clean and free of all mortar droppings, splashes, smears, stains etc.

Include for hacking and raking out joints of all walls as required to receive plaster, screeds, or other finishes.

### 5.2.9 Ant and Damp Proof Courses

Unless otherwise indicated on the drawings the ant proof course shall consist of a bed of cement and sand composed of one part cement to three parts (1:3) by volume and not less than 30 mm thickness laid over the whole area of walls and piers, finished to a smooth level surface with the edges pointed flush with the faces of the walls. Before laying the ant proof course the top of all walls shall be cleaned and well wetted, and after it is laid it shall be carefully protected until firm and covered with damp soaking.

When the ant proof course is hard it shall be covered with a damp proof course of Hessian based bituminous felt in accordance with BS 743 Part 2 unless otherwise described in the Particular Specification or Bills of Quantities.

Before laying the damp proof course the ant proof course shall be cleaned and brushed and any projections in the surface leveled off. The damp proof course shall then be laid and bedded on a thin bed of cement mortar and

neatly pointed on the exposed edges. Joints in the running length shall be made in the damp proof course by horizontal laps of not less than 225mm and at intersections of walls the lap shall be equal to thickness of the interacting wall or partition.

Damp proof course as described shall be laid under all internal walls where these are built off the ground floor slab.

### **5.2.10 Provisions, Allocations for other works**

The Contractor shall:

- a) Do all necessary cutting and bonding up to other work and perform all rough and fair cutting required. Leave or form all chases for edges of concrete floors, roofs, staircases, landings, etc., and provide chases for pipes conduit and the like and make good.
- b) Rake out joint or form grooves for flashings, turn-ups etc., and the like as required and point in cement mortar as described.

Where shown on the drawing, all walls shall be carried up to the underside of the roof sheets and shall be splayed out on top edge to suit roof slope and the corrugations or tiling flushed up solid in gauged mortar as described.

Level all wall plates, bed in gauged mortar and secure with 25 mm x 16 S.W.G. (1.63mm) galvanized hoop iron straps 900 mm long and 1250 mm apart bedded in walls and bent around, drilled and spiked to plates.

Build in or cut and pin in cement mortar ends of cills, thresholds steps lintels and the like and make good.

Leave or form holes for all pipes, conduit and services and make good.

Sills shall be bedded in cement mortar and jambs and heads bedded in gauged mortar and pointed in cement mortar unless otherwise described or indicated on the drawings.

Concrete lintels shall be provided with suitable plugs for the fixing of heads of wood frames.

Flues shall be formed as shown on the drawings and parged with gauged mortar not less than 20 mm thick and core on completion.

Rough render in gauged mortar not less than 12 mm thick to the faces of all flues where passing through timber roof or floor spaces or where passing less than 150 mm from the face of any timbers.

Carefully fill up all putlog holes as scaffolding is dismantled and where required face up to match adjoining work.

Cut away for and attend upon as required and make good after all trades.

Screeds shall be brushed with a stiff bass broom to remove any surface dust or debris before felt laying commences.

## 6. ROOFING

### 6.1 General

Roofing sheets shall generally be fixed in accordance with BS EN 501 except where the contract drawings or documents expressly override or modify this specification.

### 6.2 Steel Sheet

The galvanized corrugated steel roof sheets shall be generally in accordance with BS 3083 having a steel sheet not less than 0.559 mm (24 S.W.G) thick with a coating of zinc on both sides with a total weight of not less than 610 and not more than 763 grammas per square meter of steel surface area.

Sheets shall be laid with 150 mm end laps and side laps of one and half corrugations on the side away from the prevailing wind otherwise lapping shall be to the full extent indicated on the contract drawings or documents. Laps shall be not less than 150 mm long.

When timber purling are employed sheets shall be securely fixed to same on the crown of the corrugations at not less than 300 mm centers with 6 mm diameter galvanized drive screws each not less than 62 mm long with head and galvanized embossed curved washer under.

Sheets shall be fixed to steel purlins with 8 mm diameter galvanized mild steel hook bolts of 50 mm longer in the shank than the depth of the steel purling to which they are fixed each with nut and galvanized embossed curved washer. The sheets shall be fixed at not less than 300 mm centers on the crown of the corrugations.

Where sheets are required to be stitched together they shall be joined at not less than 300 mm centers with 6 mm diameter and finished clean without rags, burrs or damage to the surrounding zinc coating.

Ridges shall have a roll top and plain wings not less than 450 mm girth all in galvanized steel sheet not less than 0.559 mm (24 S.W.G) thick and fixed in similar manner to the sheeting.

At square abutments the last two corrugations of the corrugated iron sheets next to walls shall be flattened and turned up against the wall and covered with 24 S.W.G galvanised iron apron flashing.

Holes for bolts or screws shall be punched from the inside of the sheet and shall be in the ridges of the corrugations as fixed and not in the holes.

Bat proofing shall be profiled fillers consisting of Polyethylene (PEL) or Ethylene Propylene Diene Monomer synthetic rubber (EPDM) material with the following minimum requirements:-

- 25-50mm thick
- Density not less than 33Kgs/m<sup>3</sup>.
- Service temperature of -70 to +95°C
- Water absorption of not more that 0.5% (28 days)

### 6.3 Aluminum Sheets

The aluminum corrugated roof sheets shall be in accordance with BS 6100 -

1.3.2 having a minimum thickness of 0.559 mm (24 S.W.G.)

The aluminum troughed roof sheets shall be in accordance with BS 6100 - 1.3.2 Type A or B as specified in the Contract Documents having a minimum thickness of 0.9 mm ( 20 S.W.G.) and 1.2 mm ( 19 S.W.G.) respectively.

Sheets shall be lapped to the full extent indicated on the contract drawings or documents.

Corrugated roof sheets shall be fixed to timber purlins and corrugated roof sheets and troughed roofs sheets shall be fixed to steel purlins all as before described for galvanized corrugated steel roof sheets unless otherwise specified.

Troughed roof sheets shall be fixed to timber purlins on the crown of the trough at not less than 300 mm centers with 6 mm galvanized embossed washer under to give not less than 50 mm penetration of the purlins to which they are attached.

Sheets shall be stitched all as before described for galvanized corrugated steel roof sheets.

All holes in sheets shall be neatly drilled or punched, of the required diameter and finished clean without rages, burrs.

Ridges shall have a tool top and plain wings not less than 450 mm girth having a minimum thickness of 0.71 mm ( 22 S.W.G.) and fixed in a similar manner to the iron sheeting. Laps shall be not less than 150 mm.

## 6.4 Roof Tiling

The roofing tiles shall be first quality local clay tiles of the type as specified in the contract drawings and documents and shall be similar to those obtained from a firm approved by the Project Manager.

All tiles shall be well and evenly burnt, uniform in shape, size and colour and free from cracks, twists and other defects.

Samples shall be submitted to the Project Manager for his approval before the work commences and all tiles used shall be of equal quality to the approved sample.

Ridge and hip tiles shall be saddle back or half round tiles as indicated on the contract drawings of similar quality and manufacture as the roofing tiles.

Tiles shall be carefully graded for size shape and colour upon delivery and again before fixing.

All tiles shall be carefully stacked on edge in the site and rows of tiles shall be separated with a layer of straw, elephant grass etc. between each to prevent damage.

Any chipped, cracked or defective tiles shall not be used.

Nails, when required, shall be stout zinc nails not less than 36 mm long.

Mortar for bedding shall be gauged mortar as before described and if required shall be tinted with an approved colouring compound to match the

tiling.

When required, tile battens shall be of sawn pressure impregnated structural timber as described in Carpenter.

Tile battens shall be not less than 50 x 35 mm sectional area or as indicated on the drawings and shall be accurately spaced at the specified gauge and securely fixed at the intersection with each rafter with 75 mm stout round wire nails.

All tiling is to be laid with the specified lap and when laid on battens the head of each tile shall be securely double nailed to the battens in every alternate course unless otherwise described.

An underlining of "Sisalkraft" orange label or other equal and approved reinforced waterproof paper shall be provided under all tiling battens. The paper shall be laid over the rafters with the length of the roll at right angles to same. Laps at heads of adjacent sheets shall be laid over the rafters with the length of the roll at right angles to same. Laps at heads of adjacent sheets shall be not less than 75 mm and at the ends 300 mm. End laps shall be made at a rafter. Sheets shall be lightly tacked in position to prevent movement whilst tiling battens are being fixed.

Form all verges, eaves, valleys, hips etc. as described, do all cutting, replace all broken or damaged tiles and leave all perfect and watertight on completion.

## 6.5 Bituminous Felt Roofing

Roofing shall be of three layers of bituminous felt all of which must be of Tropical Grade with a softening point temperature of not less than 104°C, and shall comply with BS 747 except where this is inconsistent with this temperature requirement.

The three layers shall be of self finished Glass Fibre Felt weighing not less than 18.1 kg/ 10 m<sup>2</sup>.

Oxidized bitumen shall be used for bedding and bonding felt layers and shall be applied hot and shall have a softening point temperature of not less than 104°C.

The first layer of felt shall be secured on all edges of the roof with hot bitumen in strips 150 mm wide, the surfaces beneath these stripes being primed with a cold cut-back bitumen. The main areas of the felt shall be spot stuck at 1800 mm intervals staggered and in very exposed situations this spacing shall be reduced to 900 mm.

The upper layers shall be continuously bedded and bonded in hot bitumen applied at the rate of 14.65 Kg/ 10 m<sup>2</sup> and shall be laid with lapped joints at all edges, side laps being not less than 50 mm and end laps not less than 75 mm wide, and each layer shall be laid breaking joint, the felt being laid in the direction of the fall starting from the eaves.

The top layer where so described shall be surface dressed with light coloured quartzite or marble mineral gauged 6 to 12 mm of rounded shape, samples of which must be approved by the Architect, laid shoulder to shoulder at the rate of 16 Kg/ m<sup>2</sup>. Alternatively, and where so described instead of the described in-situ surface finished or Glass Fibre Felt weighing not less than 27.2 Kg/ 10 m<sup>2</sup> with a factory applied mineral surface dressing to a specification not inferior to the above described in-situ dressing.

Built-up felt roofing shall not be laid under wet, damp or humid conditions and the substructure and screeds shall have been allowed to set thoroughly and dry out for at least seven days before felt laying is commenced and the surface must be completely free from all moisture, dirt and dust.

The Contractor shall satisfy himself that the sub-structure and screeds are in fit condition to receive the felt and that falls are adequate and not less than 1: 80. All flashings, turn-downs at edge, etc., shall be generally in accordance with BS 8217.

Prices for built-up roofing shall include for all straight cutting and waste.

The contractor will be required to guarantee the whole of the bituminous felt roofing against defective workmanship and materials and maintain as required for a period of five years from the date of the Practical Completion of the Works notwithstanding anything to the contrary contained in the Contract Conditions.

## **6.6 Roofing Shingles**

Shingles roofing shall have two layers, bituminous felt water proofing layer that complies with BS 747 and shingles that are placed on the bituminous felt. Shingles shall comply with BS 5534.

## **6.7 Proprietary Roofing Systems**

When Proprietary of Specialist roofing systems are required to be used as specified in the contract documents they shall be carried out strictly in accordance with the proprietors or specialist manufacturer's instructions. Under no circumstances will any deviation there from be allowed.

## **6.8 Roof Screeds**

The lightweight concrete roof screeds shall be mixed strictly in accordance with the specification of the manufacturers.

The surface of the concrete roof on which the screeds are to be laid shall be perfectly dry before laying commences.

The screeds shall be laid to fall of not less than 1 in 80 to give falls and cross falls as indicated on the drawings and the surface floated perfectly smooth and free of all irregularities and projections to receive the felt roofing.

On completion of the screeds they shall be covered with a waterproof cover to prevent too rapid drying or the reabsorption of rainwater before being covered with felt.

Screeds shall be brushed with a stiff brass broom to remove any surface dust or debris before felt laying commences.

## **6.9 Make Good**

Carefully inspect all roofing works on completion and make good or replace all defective materials and workmanship, clean out all eaves, gutters, rainwater outlets, etc. and leave all perfectly sound and watertight.



## 7.0 CARPENTRY

### 7.1 Timber

Timber for carpentry work shall be well seasoned preservative treated timber as later described, graded and free from defects in accordance with The Timber (Export and Grading Rules 1967) and obtained from an approved Uganda sawmill.

Hardwood shall be second or selected grade in accordance with the "Hardwood Timber Grading", and softwood shall be in accordance with the Second Strength Grade of the "Softwood Strength Grading Rules".

All timber shall be free of live borer, rot and decay, brittle heart and compression failure and loose unsound or dead knots.

All timber shall be grade marked as specified in the Grading Rules and certificates of Grading shall be produced for verification by the Project Manager.

In as much as is practicable, timber shall be purchased immediately after the contract is signed to enable it to be adequately seasoned before required for use.

The timber referred to above shall be referred to in the Particular Specification or Bills of Quantities as "Carpentry Timber as described" and may consist of any of the following timbers listed in Table 7.1.1 below

Table 7.1.1 – Carpentry Timber

<b>HARDWOODS</b>	
BOTANICAL NAME	TRADE AND LOCAL NAME
Symphonia globulifera	Muyanja, Munyeya
Piptadeniastrum africanum	Dahoma, Muwere
Chrysophilum spp.	Mululu, Mubakampungu, Munyamata
	Muhumbulya, Mulyanyonyi
Drypetes spp.	Mushabarara
Carapa grandiflora	Mujogo, Mutongana
Celtis spp.	Lufogo, African Celtis
Fagara spp.	Akasinsa, Namamuka, Mukomakoma
Croton spp.	E. Satinwood, Munyene
Trichilia spendida	Musine, Mutundu, Muhote
	Sekoba, Sesambya
Pterygota mildbraedii	Mukoko
Eucalyptus gaudis	Eucalyptus, Kalitunsi
Grevillea robusta	Australina Silky Oak
Markhamia platycalyx	Musaribya
Newtonia buchananii	Muchenche, Mpewere
Albizia (All species except A Coriaria)	Nongo, Murongo, Mulera
Funtumia spp.	Musanda, Nkago, Wild Rubber
Aningeria spp.	Osan, Mutoke
Bosquiea phoberos	Mugwi, Katomatoma
Maesopsis eminii	Musizi
Antiaris toxicaria	Durundu, Muhehere
<b>SOFTWOODS</b>	
Podocarpus spp.	Podo
Pinus spp.	Pine

## 7.2 Timber for Special Structures

Timbers for designed structural work requiring timber of high strength and quality will be specified by name in the Particular Specification or the Bills of Quantities, and in accordance with the Uganda Code for Structural Design

## 7.3 Preventive Treatment for Timber

All timber for carpentry work shall be vacuum pressure treated with Celcure or Tamalith or other approved medium, toxic to termites, cryptoterms and other timber pests. All cut ends of timber so impregnated shall be treated with two coats of "B" crystals or other approved method.

A "charge sheet" giving details of treatment shall be supplied to the Project Manager if he so directs.

Pressure treatment shall be carried out by a specialist firm with approved equipment.

## 7.4 Seasoning

Timber shall be seasoned after preservative treatment has been carried out to a moisture content as shown in table 7.4.1 below.

**Table 7.4.1: Moisture content of timber for various positions in building**

Position	Moisture Content of Timber in its Permanent Position%	Moisture Content of Timber at Time of Erection%
Rafters, battens, trusses	15	22
Floor joists	15	22
T and G flooring	12-14	15-22

After delivery to site, timber shall be carefully stacked to ensure free circulation of air throughout the stack and covered with a waterproof cover to prevent excessive drying by the sun or reabsorption of rainwater.

## 7.5 Samples and Testing

The Project Manager may select any samples of timber he may require for the purpose of testing i.e. strength, moisture content penetration of preservative, identification of species etc.

Samples for testing shall consist of cross sections not exceeding 50 mm thick out at least 500 mm from the end of the piece. They shall be packed in polythene bags with the ends tightly tied, labeled and delivered either to the Government Chemist the Chief Materials Engineer, Central Materials Laboratory of the Ministry responsible for Works or any approved laboratory as directed.

## 7.6 Sawn Timber

All timber, except as specified elsewhere, shall be die square clean sawn as left from the saw and shall hold the full dimensions specified.

### 7.7 Wrot Timber

The term "wrot" shall mean finished to a perfectly smooth finish to receive paint or other surface treatment. Pieces which have been machine planed shall be finely smoothed by hand plane and glass paper or sanding machines to remove all planning machine or other marks.

3 mm reduction of specified size will be allowed in respect of each wrot face except in members 25 mm thick or less or where described as finished size "finished" when the members shall hold the full size stated.

### 7.8 Workmanship

All carpentry work shall be executed by skilled workmen, with workmanship of the best quality, accurately set out in strict accordance with the drawings and be framed together and securely fixed in the best possible manner with properly made joints; all brads, nails and screws etc., shall be provided as necessary, directed and approved, and the Contractor's prices shall allow for all the foregoing.

### 7.9 Jointing

All timber shall be as long as possible and practicable to eliminate joints. Where joints are unavoidable surfaces shall be in good contact over the whole area of the joint before fastenings are applied.

Scarfed joint shall be of a length not less than twice the greatest dimension of the timber member and shall be bolted if required. Whenever practicable scarfed joints shall be placed at a point of support in order to obtain maximum strength.

No nails, screws or bolts shall be placed in any split end. If splitting is likely, or is encountered in the course of the work, holes for nails shall be prebored at diameter not exceeding 4/5th of the diameter of the nails. Clenched nails must be bent at right angles to the grain.

Lead holes shall be bored for all screws. When the use of bolts is specified the holes shall be bored from both sides of the timber and shall be of the diameter  $D + D/16$ , where D is the diameter of the bolt. Nuts must be brought up tight but care is to be taken to avoid crushing of the timber under the washer.

A tolerance of 1 mm will be allowed in positioning of bolt holes.

### 7.10 Connectors

When trusses are required to be bolted together with timber connectors, the single or double sided toothed type connectors shall be used, in accordance with relevant standard or as directed by the Project Manager on Connectors for Timber.

### 7.11 Nails and Bolts

All nails, bolts and metal fastenings shall be of mild steel, free of all rust and defects and of approved manufacture.

### 7.12 Roofs

The roofs shall be constructed in accordance with the details and scantlings shown on drawings. All ironwork necessary at joints, etc., is to be fitted and bolts, nuts and washers provided and fixed as required. Trusses shall be hoisted into position at the spacings shown and such temporary struttings as may be required shall be provided. Purlins shall be of the size and intervals shown. Rafters shall be cut and splayed as shown on the drawings. Plates shall, so far as possible, be in one length between points of change of direction. Joints between continuous lengths or at changes of direction and intersections shall be halved.

### 7.13 Ends of Timber

The ends of all cut timbers, whether exposed, built in or otherwise shall be painted with two coats of "Wykamol" or other equal and approved to prevent rot and entry of borers.

### 7.14 Fixing Slips and Plugs

The Contractor shall provide and fix all necessary hardwood plugs and fixing slips to walls and dovetailed blocks cast into concrete soffits, etc., for the purpose of providing fixings for joinery and other Trades.

All hardwood fixings shall be clean and dry and dipped in "Wykamol" or other approved wood preservative before fixing.

Where work is described as "plugged" it shall be fixed with nails to treated hardwood plugs inserted into the brick or block work joints. Plugs shall be of dry hardwood with the end cut on the twist, dipped in "Wykamol" or other approved wood preservation and tightly driven into the raked out joint in the wall.

Where work is described as "plugged and screwed" it shall be fixed with steel screws unless otherwise specified to cylindrical fibre or polyvinyl plastic plugs of approved manufacture let into holes of suitable size drilled in the walls. When the wall is of such a material that it is impossible to drill neat round holes they shall be packed with a suitable plastic plugging compound such as "Rawplastic" or "Philplug" or other similar approved as instructed by the manufacturers.

Plugs shall be inserted in walls to provide fixings not more than 750 mm apart horizontally. The number of plugs at each fixing point will depend on the width, height and thickness of the material to be fixed but a minimum of two will be required with an additional one for each 150 mm width or height in excess of the first 150 mm.

### 7.15 Insect Damage

All timber brought on to the site shall be free of live borer beetle or other insect infestation and it will be the responsibility of the Contractor to see that it remains free of infestation until the end of the maintenance period.

If upon inspection any timber is found to have been attacked, the Contractor shall be required to execute at his own expense all necessary remedial measures to eradicate it, including the removal and replacement of all infected timber and such other measures as he is directed to take by the Project Manager.

### **7.16 Cleaning**

The Contractor shall remove and destroy all cut ends, shavings and other wood waste from all parts of the building and the site generally both whilst the work is in progress and at its completion.

## 8.0 JOINERY AND IRONMONGERY

### 8.1 Timber

Timber for joinery work shall be well seasoned preservative treated timber all as described in Clause 7.1 "Carpentry" with the following exceptions:-

Hardwood shall be First or Prime Grade in accordance with the "Hardwood Timber Grading" and softwood shall be in accordance with the First Appearance Grade of the "Softwood Appearance Grading Rules".

**Table 8.2.2: Hardwoods for High Class Joinery Work**

BOTANICAL NAMES	TRADE AND LOCAL NAME
Albizia coriaria	Mugavu, Musisi, Murongo
Fagara spp.	E.A. Satinwood, Munyenye
Chlorophora excelsa	Iroko, Muvule
Fagaropsis angolense	Mafu, Muyinja, Mumara
Entandro phragma	
Cyclindricum	Sapele, Muyovu
E. Utile	Utile, Mufumbi
Lavoa spp.	Nkoba, Mukusu
Entandrophragma Engolense	Godu Nohor, Mukusu
Guarea cedrata	Scented guarea
Khaya spp.	African Mahogany Munyama

### 8.2 Species of Timber for Joinery Works

The timber referred to in the previous Clause will be referred to in the Particular Specification or Bills of Quantities as "Joinery Timber as described" and may consist of any of the following timbers:-

Table 8.2.2 - Hardwoods for High Class Joinery Work

Botanical Name	Trade and Local Name
<i>Symphonia globulifera</i>	Nuyanja, Munyeya
<i>Piptadeniastrum africanum</i>	Dahoma, Muwere
<i>Chrysophilum</i> spp.	Mululu, Mubakampungu, Munyamata Muhumbulya, Mulyanyonyi.
<i>Drypetes</i> spp.	Mushabarara
<i>Carapa grandiflora</i>	Mujogo, Mutongana
<i>Celtis</i> spp.	Lufogo, African Celtis
<i>Fagara</i> spp.	Akasinsa, Namamuka, Mukomakoma
<i>Croton</i> spp,	E. Satinwood, Muynene,
<i>Trichilia spendida</i>	Musine, Mutundu, Muhote Sekoba, Sesambya
<i>Pterygota mildbraedii</i>	Mukoko
<i>Eucalyptus gaudis</i>	Eucalyptus, Kalitunsi
<i>Grevillea robusta</i>	Australian Silky Oak
<i>Markhamia platycalyx</i>	Musaribya
<i>Newtonia buchananii</i>	Muchenche, Mpewere
<i>Albizia</i> (All species except <i>A. Coriaria</i> )	Nongo, Murongo, Mulera
<i>Futumia</i> spp.	Nusanda, Nkago, Wild Rubber
<i>Aningeria</i> spp.	Osan, Mutoke
<i>Bosquiea phoberos</i>	Mugwi, Katomatoma
<i>Maesopsis eminii</i>	Musizi
<i>Antiaris toxicaria</i>	Durundu, Muhehere



### **8.3 Preventive Treatment**

Preservative treatment of all timber for joinery work shall be carried out in accordance with Clause 7.3 "Carpentry".

### **8.4 Seasoning**

Timber shall be seasoned after preservation treatment has been carried out to moisture content as described with Clause 7.4 "Carpentry".

Seasoned timber shall be stored inside an enclosed building until required for use.

### **8.5 Samples for Testing**

The Project Manager may select samples for testing all as described in Clause 7.5 "Carpentry".

### **8.6 All Joinery to be Wrot**

All joinery timber shall, unless specifically so described, be wrot within the definition given in Clause 7.6 "Carpentry"

### **8.7 Selected Timber for Polish**

When timber is to be lacquered, varnished or polished this will be specifically described in the Particular Specification or Bills of Quantities as "hardwood/ softwood selected and kept clean for polish".

Such timbers shall be carefully selected and matched for uniformity, symmetry and evenness of both grain and colour.

### **8.8 Plywood**

Plywood shall comply with BS 6566, Parts 1 -8 – Plywood manufactured from Tropical Hardwoods, of the first grade. Plywood for external use shall be weatherproof resin bonded, Bonding W.B.P. Quality.

The Project Manager may require samples for testing in accordance with the provisions in the relevant B.S or Uganda Standard and the Contractor shall supply these and he will be reimbursed with the cost as previously described.

### **8.9 Block Boards**

Block boards shall comply with BS 8701 and shall be of the first grade. Blackboard for external use shall be weatherproof resin bonded, Bonding W.B.P. quality. Tests may be called for as previously described.

### **8.10 Wood Chipboards**

Chipboard shall comply with BS 5268 and unless otherwise specified the faces shall be filled and finished to receive paint. Tests may be called for as previously described in BS EN 181104 .

### 8.11 Veneers

When veneering of blackboards, chipboards, etc. is required, it shall be carried out in an approved manner. The sheets of veneer in adjacent panels shall be carefully matched for uniformity of colour and symmetry in the direction of the grain, laid with tight edges and secured with approved adhesives under pressure to the base.

### 8.12 Adhesives

Organic or casein glues in accordance with BS EN 12765 may be used for all non-load bearing internal work or work where the moisture content will never exceed 15%.

For external work or when the moisture content is likely to exceed 15% only resin type adhesives in accordance with BS EN 12765 shall be used.

### 8.13 Nails and Screws

Nails shall be as described in "Carpentry". Screws shall, unless otherwise specified, be steel screws in accordance with US.194-1 or BS 1210 "Wood Screws".

Unless elsewhere described, nails shall be of length equal to two and a half times the length of the material which is being fastened and screws shall be not less than No. 8 gauge and of a length not less than twice the thickness of the timber being fixed.

### 8.14 Workmanship

The Joinery work shall be carried out by skilled workmen and in an approved manner exactly in accordance with the Project Manager's detail drawings.

The joiner shall carry out all necessary mortises, tenons, rebates, grooves, notching, tongues and housings and all other labours necessary for correct jointing. He shall also provide all tongues, dowels, metal plates, screws, nails and other fastenings that may be required for the proper carrying out of the work.

The joiner shall carry out all works necessary for the proper construction of all frames, linings, panels, etc. and their support and fixing in the building. All joinery work shall be arranged, jointed and fixed to allow for minimum shrinkage and damage either to its strength or appearance.

Joinery work shall be commenced as soon as practicable and all frames and components shall be loosely framed and assembled, but they shall not be finally glued, pinned and wedged until they are required for fixing on site.

Where joints shall be commenced as soon as practicable and all frames and components shall be loosely framed and assembled, but they shall not be finally glued, pinned and wedged until they are required for fixing on site.

### 8.15 Joints

Where joints are required even though not specifically indicated on the drawings, they shall be the recognized form of joint for such positions and

shall be made in accordance with BS 1186- 2 and BS 1186– 3.  
All nails shall be punched and stopped with linseed oil putty.

Loose joints shall be made where provision for shrinkage is required e.g. tongued and grooved in fill or paneling.

Glued joints shall be made when the joint has to be sealed or when shrinkage or other movement in the boards, etc. can be discounted. In glued joints all surfaces in contact shall be sawn or wrot and shall be perfectly clean and free from dirt, dust, sawdust, oil and any other contaminating matter likely to impair the strength of the joint. All joints shall be properly cramped until the wedges and pins are driven or subjected to adequate pressure which shall be maintained until the glue has set.

All glues shall be used in accordance with the manufacturer's instructions.

### **8.16. Moulding**

All mouldings shall be accurately worked in accordance with the details and unless otherwise specified shall be worked on the solid.

### **8.17. Fixing or Building Frames**

All frames for normal joinery construction shall be built-in as the adjoining walling or masonry is carried out.

Frames which are to receive polish or other clear finish previously referred to shall be carefully stored until the openings to receive them are completed and all plastering or other wet trades are finished and then "built-in"

### **8.18 Fixing Beads etc**

Except as otherwise described all beads, fillets and small mouldings, architraves and skirtings which are not required to be removed shall be fixed without stout round or oval pins, brads or nails.

When specifically stated, work shall be fixed with steel or brass screws with the heads let in and pelleted with matching wood pellets.

All glazing beads for doors and opening lights and beads for securing mosquito gauze to all types of frames shall be fixed with brass cups and screws.

### **8.19 Scribing**

All skirtings, cover fillets, architraves etc. shall be accurately scribed to fit to the contours of any adjacent irregular surfaces to form a close butt joint.

### **8.20 Grounds**

Provide and fix where indicated on the drawings, particular specification or bills of quantities all necessary sawn grounds to receive skirtings, linings and other "built-in" fittings, etc.

## 8.21 Flush Doors

Flush doors unless specifically otherwise described, shall consist of hardwood skeleton framing 75 mm wide to all stiles top and bottom rails, 50 mm wide horizontal intermediate rails not more than 150 mm apart, with suitable blocks to receive mortise locks on each long edge and covered on both sides with 6 mm plywood finished for paint and approved hardwood lipping 30 mm thick on each vertical edge.

All flush doors unless otherwise described shall be 45 mm finished thickness and shall be properly framed and put together in accordance with the requirements of BS 459.

External quality flush doors where so described shall be as described above except that the plywood shall be external quality bonding W.B.P. plywood as previously described and all adhesives used shall be of the resin type.

All flush doors shall be perfectly plane on both faces free of all waves, ripples and distortion of any kind. Any door which after the application of paint or polish shows any of these defects shall be removed

## 8.22 Priming

All joinery work which is prepared for painting shall be knotted and primed as soon as it is prepared and ready for incorporating in the building. The backs of all frames, linings, skirting boards, bottom edges of doors and sashes etc., and other timber likely to come into contact with plaster or masonry shall be similarly primed.

Priming shall consist of one coat of priming paint in accordance with BS 2523.

Touch up priming coat of all members as necessary before finally incorporating in the Works.

## 8.23 Polish or Clear Finishes

Where Joinery is to be polished or varnished it shall be given the first coat of the selected treatment as soon as it is ready for incorporating into the Works.

## 8.24. Inspection

Facilities shall be given to the Project Manager to inspect work in the course of fabrication in the Contractor's Workshop.

## 8.25. Storage and Delivery

All completed joinery shall be carefully stored in an enclosed building until it is required for use and shall not be prematurely brought on the site.

All joinery in transit shall be carefully protected from damage and kept under a waterproof cover.

### **8.26 Protection of Joinery**

All joinery likely to be damaged after being fixed in position shall be adequately cased up and protected by the Contractor until completion of the Works.

### **8.27 Ironmongery**

All ironmongery is to be as specified in the Particular Specification or Bills of Quantities with regards to manufacture and finish.

All ironmongery shall be carefully stored, sorted, assembled and fixed in the best manner with matching screws, and shall be left oiled if required and in perfect working order.

All keys shall be stamped with an identity number corresponding to its lock and if directed by the Project Manager it shall have a stamped brass identification tag attached to it by means of a steel split ring.

All ironmongery shall be removed before painting work is carried out and after completion it shall be refixed, adjusted, cleared and left in full working order.

All damaged or defective ironmongery shall be replaced at the Contractor's own expense.

### **8.28 Dowels**

The feet of all door frames or other vertical posts or timbers shown on the drawings shall be firmly anchored to the floor with a 9 mm diameter mild steel dowel 100 mm long let into the frame, etc., and the floor for equal amounts. Dowels shall be bedded to the frame in red or white lead.

### **8.29. Mosquito Gauze**

Where indicated on the drawings mosquito gauze shall be brass or copper gauze not less than 0.559 mm (24 S.W.G) x 20 mesh.

### **8.30. Making Good**

Should any joiners work bend, shrink or warp before the end of the Maintenance period such work shall be removed and replaced entirely at the Contractors own expense together with any other work disturbed in consequence thereof to the entire satisfaction of the Project Manager.

## 9.0 METAL WORK

### 9.1 Materials generally

- (i) All materials shall be the best of their respective kinds, free from defects, and all work shall be carried out in the most workmanlike manner and strictly as directed by the Project Manager.
- (ii) The materials in all stages of transportation, handling and piling shall be kept clean and injury from breaking, bending and distortion prevented.

### 9.2 Structural Steel

Structural steel shall comply with BS 4-1: 1993 Steel of Non-British origin shall comply with the tests enumerated in BS 159: 1992 and samples shall be submitted to the Project Manager for this purpose and for his approval.

All structural steelwork shall be fabricated in accordance with BS 449-2:1969 – The use of Structural Steel in Building.

### 9.3 Welding

Welding of steel shall be carried out strictly in accordance with BS 5950 – General requirements and/or DD ENV 1090 Eurocode.

### 9.4 Bolts

All bolts shall be of the best quality mild steel of lengths and weights approved by the Project Manager. Bolts shall project at least two threads through nuts and all bolts passing through timber shall have washers under heads and nuts.

### 9.5 Metal Windows and Doors

All metal windows and doors shall unless otherwise specifically described be of the domestic type in accordance with BS EN 990: 1996 – Steel Windows generally for Domestic and Similar Buildings.

Windows generally shall be Standard Metal Windows of the type and layout shown on the drawings, constructed from sections rolled from best quality mild steel. Corners shall be electrically welded and glazing bars shall be locked at points of intersection and machine tenoned to frames. All welds shall be ground flush and all frames and casements shall be square and free from deformity of any kind.

### 9.6 Hanging

All casements shall open as indicted on the drawings and shall be fitted with projecting hinges with bronze or gun – metal pins horizontal pivot hung windows shall be fitted with bronze friction centers. All fittings shall be of bronze or gun-metal.

## 9.7 Fittings

All side hung windows shall be fitted with double notched wedge plate casement handle and peg casement stay not less in length than three quarters of the width of the opening light and suitable retaining pin welded to the frame.

Horizontally hung windows shall be fitted with a peg casement stay as above described but pivoted windows shall be fitted with spring loaded catches with either ring handle for pole operation or where specifically so described, gears for remote control operation.

Doors shall be hung on heavy pattern projecting type hinges with bronze of gun – metal pins and fitted with a three lever mortise lock of “Union” or other equal approved manufacture with two keys and bronze handles to each. One leaf of folding doors shall be fitted with two 150 mm bronze concealed bolts.

## 9.8 Glazing Clips

All sections shall be slotted or drilled to receive glazing clips.

## 9.9 Fixing Lugs and Screws

Adequate mild steel fixing lugs and screws shall be provided at not more than 450 mm centers at jambs, heads or cills and where these are less than 450 mm in length they shall be fitted with not less than one lug per member. Lugs shall be of the adjustable type for building into walls with slotted holes to allow vertical adjustment of the fixing screws.

Frames shall be screwed either to the fixing lugs or direct to wood frames with suitable screws.

Frames fixed direct to masonry brickwork shall be fully bedded in gauged mortar and neatly pointed all round externally in an approved waterproof mastic compound. Frames screwed into wood sub-frames shall be bedded in approved waterproof mastic compound before screwing in position and the surplus mastic neatly dressed off and pointed on both sides.

## 9.10. Composite Windows

Composite windows and doors shall be provided as shown in the contract documents and shall include for all necessary coupling mullions, transoms and cills etc. as indicated.

All mullions and transoms shall be bedded in approved mastic.

## 9.11. Protective Finish

All metal windows shall be given one coat of approved red oxide paint at the works. The metal shall be thoroughly cleaned before the paint is applied.

After delivery to the site the paint coat shall be touched up with similar paint as required before the application of subsequent coats.

## 9.12 Fly Screens

Where fly screens are indicated on the drawings unless specifically otherwise shown these shall be manufactured in accordance with the shop drawings provided by the Contractor and approved by the Project Manager..

The frames, opening lights and mullions shall be manufactured from good quality mild steel all properly framed and welded together.

Where plate mullions and transoms are required these are to consist of 1.626 mm thick sheet 112 mm girth with one edge bent, drilled and set screwed to the window and the other edge drilled and set screwed to the metal angle frame of the fly screen.

Opening lights shall be provided with one pair of brass hinges and two brass turnbuckles to each and filled in with 20 mesh x 10.274 m (32 S.W.G) brass gauge screwed with mild steel beads fixed to the inside of the angle frame.

All fly screen frames shall be thoroughly cleaned and prepared at the manufacturer's works and painted with one coat of approved red oxide paint.



## 10.0 PAVING

### 10.1 Cement

All cement shall be as described in Clause 4.2 "Cement".

### 10.2 Sand

Sand for paving shall be clean well graded sand in accordance with BS 1199: and BS 1200, and shall be washed if required.

### 10.3. Granolithic Coarse Aggregate

Coarse aggregate for granolithic paving shall be clean properly graded quartzite chippings finely crushed to pass a 6 mm mesh and down but free from dust and organic matter.

### 10.4. Water

Water shall be as previously described.

### 10.5. Granolithic paving

The mix for granolithic paving concrete shall consist of one part cement, one and a quarter parts sand and two and a half parts coarse aggregate as described by volume (1 : 1¼ : 2½).

If the coarse aggregate grading approaches the upper limit of 20% passing a 4.5 mm sieve the proportion of sand should be reduced accordingly.

The provisions of "Concrete" regarding batching and mixing shall apply to granolithic concrete and in all cases the water content shall be kept as low as possible consistent with obtaining full compaction.

The paving may be laid:

- i. **monolithic** with the concrete base under i.e. within 3 hours of the base being laid, or
- ii. **as separate construction** i.e. after the concrete base under has been allowed to dry and attain its full strength.

The special conditions applying to laying, thickness and size of bays for each method are fully described hereafter.

All paving shall be thoroughly compacted without segregation or excessive laitance.

After placing, leveling and compaction the topping shall be trowelled at least three times at intervals during the next 6-10 hours so as to produce a uniform, dense and hard surface with as much coarse aggregate just below the surface as possible. During the second subsequent trowellings any laitance shall be removed. The final trowelling should be at such a time that considerable pressure is required to make an impression on the surface. Under no circumstances should cement be sprinkled on the surface and trowelled in to absorb surplus water.

As soon as the surface has been finished it shall be shaded from the sun and breeze to prevent rapid drying. Immediately the surface has hardened sufficiently it shall be covered for at least seven days with damp sand or hessian, building paper, plastic etc., and shall be kept completely and continually damp. After the curing period it shall be allowed to dry out slowly.

### **10.6. Granolithic Paving (Separate Construction)**

The area of bays shall be determined by the layout, the structure and the method of construction to be adopted. The position of construction joints, movement joints and day work joints in the base shall be carefully planned in relation to the layout as such joints will necessitate corresponding joints in the paving. The paving to be laid in areas not exceeding 15 sq. metres or in panels the length of which shall not exceed 1½ times their width. Plastic or ebonite strip as described shall be used to define the joints in the paving and over all bays and load bearing walls.

The base shall be thoroughly hacked shortly before the paving is to be laid to provide a good bond. All laitance shall be removed to expose the coarse aggregate and all dust and dirt cleaned out. The base shall be thoroughly wetted but all excess water removed before grouting. If the paving is to be laid less than 24 hours after the base, preparation may be done by wire brushing.

Before paving is placed a thin layer of grout consisting of cement and water mixed to the consistency of thick cream shall be brushed into the surface of the base. The grout shall be followed immediately by the paving as previously described.

The paving, when fully compacted, shall be not less than 36 mm + 6 mm and service pipes or conduit shall not be laid in it.

### **10.7 Granolithic Paving (Monolithic)**

Where the thickness of base and paving is 150 mm or greater the area of individual slabs shall not exceed 30 sq. metres.

When the thickness of base and paving is between 100 mm and 150 mm the area of slabs shall not exceed 15 sq. metres.

The area and shape of slabs will depend on the layout of the building but shapes approaching square shall be preferred and in no case shall the longer dimension exceed 8 metres. Plastic or ebonite strip as described shall be used to define the joints in the paving and over all beams and load bearing walls.

The paving, when fully compacted, shall be average 19 mm thick with a minimum thickness of 12 mm.

### **10.8 Chemical Surface Treatment**

Integral hardeners or surface treatments where specified shall be used strictly in accordance with the manufacturer's instructions.

## 10.9 Screeds

Screeds for in-situ terrazzo and other tile pavings shall consist of cement and sand (1:3) and shall be laid in a similar manner as described for granolithic paving (monolithic or separate) to the specified thickness and finished with wood float or steel trowel to suit the type of finish as specified in the Particular Specification or Bills of Quantities.

## 10.10. Terrazzo Paving

The materials used and method of laying is to be in accordance with BS 8204.

The terrazzo paving is to be of an approved colour as selected by the Project Manager and composed of two parts of white or coloured marble chips to one part tinted white cement laid rolled and trowelled to a dense even surface and rubbed down at completion to a grit finished surface free from holes and blemishes.

Terrazzo paving shall not be less than 15 mm finished thickness and laid in panels 1000 x 1000 mm maximum or to patterns as indicated on the drawings and divided by ebonite or coloured plastic strips securely anchored into the screed and having their top edges finished flush with the surrounding paving.

The paving is to be laid on a cement and sand screed as described of the thickness indicated (but not less than 19 mm) and is to be finally ground and polished to the approval of the Project Manager. The concrete sub-floor shall be thoroughly cleaned and free from dust, grease and other foreign materials and coated with cement slurry before the laying of screeds and paving.

## 10.11 Concrete and Quarry Tile Paving

Concrete floor tiles and fittings shall comply in all respects with BS 1197-2 and samples shall be submitted to the Project Manager for testing and approval.

Quarry floors tiles and fittings shall comply in all respects with BS 6431 and samples shall be submitted to the Project Manager for testing and approval.

All tiles shall be well soaked in water before use.

Tiles shall be laid to the patterns indicated on the drawings with either close butt joints or wide joints as required.

All tiles shall be laid on a prepared cement and sand screed and bedded and jointed in cement mortar (1:3) as before described and pointed as indicated on the drawings.

## 10.12 Cork Tile Paving

Cork tile paving shall be carried out by an approved specialist firm and shall consist of medium density cork tiles each size 305 x 305 x 6 mm thick with tongued and grooved edges laid with close butt continuous joints in both directions and bedded in an approved adhesive.

Cork tiles shall be of a natural colour approved by the Project Manager.

The tiles shall be laid on a clean dry cement and sand (1:3) screed as before described and after laying shall be surfaced and sealed with three coats of approved polyurethane lacquer buffed down between coats.

### **10.13 Flexible P.V.C Floor Tiling**

Flexible P.V.C. floor tiling shall be carried out by an approved specialist firm and shall consist of tiles in accordance with B.S. 3261 of approved manufacture and colour to the sizes and thickness as indicated in the Drawings, Particular Specification or Bills of Quantities. The tiles shall be laid to the patterns as indicated (if any) on the drawings with close butt joints and bedded in approved mastic on a clean, dry cement and sand (1:3) screed as before described with a stool trowelled finish.

On completion, any surplus mastic which may have squeezed out of the joints shall be removed, the tiles cleaned with an approved cleaner and two coats of approved P.V.C. tile sealer applied.

### **10.14 Dividing Strips**

Dividing strips shall be black ebonite or plastic of approved colour to the sizes and positions as indicated on the drawings, Particular Specification or Bills of Quantities. The strips shall extend to the full depth of the pavings in which they are inserted and in the case of terrazzo work shall be let into the screed under for a depth of not less than 6 mm.

### **10.15 Cover up and Protection of Paving**

The Contractor shall cover up and protect all pavings and finishes as required to assist slow and even drying and to prevent damage by traffic. Remove all such coverings and leave the work clean and perfect at completion.

## 11.0 WALL AND CEILING FINISHES

### 11.1 Cement

All cement shall be as previously described in concrete works.

### 11.2. Lime

The lime for plastering shall comply with BS EN 459-1 or US 61 and US 155 for non-hydraulic lime and be as rich as obtainable and to the approval of the Project Manager. It must be freshly burned and shall be slaked at least one month before being used by drenching with water, well broken up and mixed and the wet mixture shall be passed through a sieve of 10 meshes to 100 square mm. Lime putty shall consist of freshly slaked lime as above described, saturated with water until semi-fluid and passed through a fine sieve, it shall then be allowed to stand until superfluous water has evaporated and it has become of the consistency of thick paste, in no case for a shorter period than one month before using, during which time it must be kept damp and clean and no portion of it allowed to become dry.

Alternatively, approved hydrated lime with average 70% Calcium Oxide CaO content may be used soaked to a putty at least 24 hours before use.

### 11.3. Sand

The sand for plaster work shall be in accordance with BS 1199 and BS 1200: It shall be clean and well graded to a suitable fineness in accordance with the nature of the plaster and the finish to be obtained.

### 11.4 Plastering Generally

Where walls are to be rendered or plastered, the joints shall be raked out 12 mm deep and brushed clean to afford a key and joints and walls shall be sprayed with clean water before rendering or plastering. Concrete surfaces shall be hacked to form key in addition.

All surfaces to be plastered must be scored for a key and brushed clean and well wetted before each coat is applied.

All materials shall be properly mixed either by hand or by machine.

Hand mixing shall be carried out on a clean properly prepared platform which shall be thoroughly scraped and cleaned between batches.

Machine mixers shall be thoroughly cleaned out between each batch.

No batch of mixture shall be used after the initial set of the cement has taken place and no material shall be allowed to stand and be subsequently "knocked" up for reuse.

All cement plaster shall be kept continually damp in the interval between application of coats and for seven days after application of the final coat.

All arrises and angles shall be clean and sharp except where the Drawings indicate otherwise.

The Contractor shall include for filling plaster into chases and working around pipes, conduits, switch boxes and outlets, into rebates, up to metal window

frames etc. and the like and for all making good.

### **11.5 Internal Plastering**

The internal plastering is to be applied in three coats and to be 16mm minimum thickness as follows:-

- a) 1<sup>st</sup>Coat – Cement and sand (1: 5 by volume), allowed to dry out thoroughly and well scratched to afford a key for the second coat.
- b) 2<sup>nd</sup>Coat – Cement and sand (1: 5 by volume), 6mm thick, finished true and level with a wood float.
- c) 3<sup>rd</sup>Coat – Cement Slurry or if lime is to be used, It shall be neat lime, plus 10% cement, not less than 2mm thick, applied as soon as the second coat can stand trowelling and finished smooth with a steel trowel.

Plastering on expanded metal lathing is to have a preliminary or pricking-up coat in addition.

The setting coat of plaster shall not be applied until all conduits, pipes and the like have been fixed and until all air bricks etc., have been fixed and all chases and cuttings in the walls have been performed and made good.

### **11.6 External Rendering**

External rendering is to consist of one part cement and five parts sand by volume (1: 5).

One coat work is to have a minimum finished thickness of 12 mm and two coats work 19 mm.

Unless otherwise described rendering is to be floated smooth with a wood float.

### **11.7 Tyrolean Finish Rendering**

Tyrolean finish rendering shall consist of a base coat of one part cement and five parts sand (1:5) by volume and a finishing coat of one part cement to four parts (1:4) of fine stone chippings 9mm and down applied to the base coat by means of an approved machine to a total finished thickness of not less than 20 mm.

The base coat shall be floated to a smooth even surface and liberally scratched to form a key.

### **11.8. Expanded Metal Lathing**

Expanded metal lathing for plastering shall be in accordance with BS 1369 and unless otherwise described in the Particular Specification or Bills of Quantities shall have a stoved black asphalt paint finish.

The lathing shall be 9 mm mesh x 24 S.W.G (0.559mm). Lathing shall be not less than 25 mm at the sides and end laps which shall be wired together at not more than 75 mm centres with stout iron tying wire. The cut ends of all tying wires shall be bent back through the lathing.

Lathing shall be fixed with the long way of the mesh across the supports and shall be fixed to same with stout galvanized staples at not more than 300 mm centres.

### **11.9. Wall Tiling**

Wall tiles shall comply with BS 6431 Glazed Ceramic tiles and Tile Fittings for Internal Walls.

All tiles shall be of the size, colour and quality as described in the Particular Specification of Bills of Quantities and shall be perfectly true to shape and free of all blemishes and flaws.

Samples shall be submitted to the Project Manager for approval.

All wall tiling shall be fixed on a perfectly plane vertical screed of cement and sand (1: 3).

Tiling shall be bedded on the prepared screed in a slurry of cement and sand (1: 4) or in an approved tile adhesive. The surface of each tile shall finish flush with the adjacent tiles. Joints shall be continuous straight joints both horizontally and vertically not exceeding 3 mm wide and shall be flushed up with white cement. Spacers shall be used to ensure that the correct joint width is maintained.

All cutting shall be kept to a minimum and the tiling shall be set out so that only the largest possible pieces of cut tiles are used.

Purpose made tiles with round on one edge shall be fixed to all vertical external angles and to the top edge of dadoes and the wall face over.

### **11.10 Expanded Polystyrene Tiles**

Expanded polystyrene tiles shall be in accordance with BS 2552.

Tiles shall be to thickness and sizes as indicated in the Drawings, Particular Specification or bills of Quantities.

All tiles shall be chamfered on all edges, close butt jointed with continuous straight joints in both directions and either nailed to timber bearers with approved panel pins with the heads neatly punched in or glued on all edges either to timber bearers or to plaster or concrete soffits with an approved adhesive.

All tiling shall be properly set out so that all cut tiles to border on all sides of a room are of equal width.

Special Note:-

Under no circumstances are these tiles to be painted, decorated or subjected to any surface treatment of any kind. Therefore great care must be exercised during handling and fixing to see that they are kept perfectly clean.

### **11.11 Insulation Board**

Insulation board shall be in accordance with BS EN 120/ 310/ 317/ 319/ 320/ 322/ 323/ 324/ 325 / 382/ 022

Sheets shall be set out to provide evenly balanced borders on all edges and shall be fixed to timber ceiling bearers spaced at 600 mm centers in both directions with stout galvanized gimp pins along each at 150 mm centers with their heads punched in and stopped. Joints between sheets shall be 3 mm wide.

Timber cornices shall be provided at the junction of all walls and ceilings as indicated on the drawings. Cornice members shall be plunged to the wall, not to the ceiling boards.

### **11.12 Flat Sheets**

Sheets shall be butt jointed and secured to timber bearers at minimum 400 mm centers with 30 mm long stout galvanized flat headed nails not more than 300 mm apart.

All holes shall be drilled (not punched) not less than 12 mm from the edge of the sheet and all nails shall be driven home so that the head finishes flush with the sheet.

Sheets to ceiling shall be set out in the same manner as described for Insulation Board.

### **11.13 Make Good**

The Contractor shall cut out and make good all cracks, blisters and other defects and leave the whole of the plasterwork perfect on completion. When making good defects the plaster shall be cut out cleanly as directed, with the edges undercut to form a good key with the surrounding work, and the new material shall finish flush with the adjacent plaster.

Tiled and sheeted surfaces shall be left perfectly clean on completion.



## 12.0 GLASS WORKS

### 12-1 Glass

All glass shall comply with BS EN 12758 and shall be free from spots, bubbles, waves and all other defects. Samples of glass shall be submitted to the Project Manager for approval.

Unless otherwise described in the Particular Specification or Bills of Quantities, sheet glass shall be ordinary glazing quality and polished plate glass shall be glazing quality. The nominal thickness of glass is to be as described in the Contract Documents.

### 12.2 Putty

The putty used in glazing in wood frames is to be whiting ground with linseed oil. That used for metal frames to be composed of whiting, linseed oil and gold size in accordance with current BS 544.

### 12.3 Glazing

Panes shall be cut with 1.5 mm clearance all round.

Generally glaze all windows with glass carefully puttied and fully back puttied, where glazing is to wood the glass must be sprigged. Carefully trim off all superfluous putty.

Glazing clips are not necessary for small panes of metal windows but should be used for the no-glazing bar types. Where no glazing bars are used the weight of the glass should be thrown on the lower hinge corner by means of small wood edges placed between the glass and the metal frame.

### 12.4 Bedding Strips

All glazing to wood doors or where otherwise directed shall be bedded in wash leather or other approved plastic shock absorbing material. The bedding material shall be cut to fit exactly the rebate line of the frame and it shall be secured with wood or metal beads fixed with cups and screws.

### 12.5 Cleaning on Completion

Remove all broken, scratched or cracked panes and replace with new to the satisfaction of the Project Manager. Clean inside and out with an approved cleaner. On no account shall windows be cleaned by scraping with glass.

## **13.0 PAINTING**

### **13.1 Workmanship**

All paintings work shall be carried out by skilled tradesmen and finished in a manner in accordance with the best acceptable trade practice.

### **13.2 Sub-letting Work**

The work shall not be sub-let to a specialist firm without the written approval of the Project Manager.

### **13.3 Materials**

All materials shall be the best of their respective kinds and shall be in accordance with their respective current Uganda Standard.

### **13.4 Paint**

All paints, including cement paint, oil paints, emulsion paint and oil bound distemper shall be ready mixed and obtained, unless specifically instructed to the contrary, from approved local manufacturers, and they shall be delivered to the site in sealed cans and shall be thoroughly mixed and applied in accordance with the manufacturer's instructions.

### **13.5 Linseed Oil**

The linseed oil to be refined linseed oil, boiled or raw.

### **13.6 Knotting**

The knotting is to be in accordance with BS 1336

### **13.7 Wax Polish**

The wax polish shall be furniture polish of an approved brand.

### **13.8 Lacquer Treatment**

Lacquer shall be an approved catalytic polyurethane lacquer and used strictly in accordance with the manufacturer's instructions.

### **13.9 Generally**

The Contractor shall arrange his programme of work so that all other trades are completed and away from the area to be painted before painting is commenced. The Contractor shall remove all concrete and mortar droppings and the like from all work to be decorated and remove all stains therefrom to obtain a uniform colour of the surface .

All materials to be applied externally shall be of exterior quality and/ or recommended by the manufacturers for external use.

Unless specially instructed by the directions and approved by the Project Manager, no paints, distemper etc., shall be used as supplied by the manufacturers and direct from the tins.

If required by the Project Manager the Contractor shall provide samples of paints and other decorative materials with containers which shall be forwarded to the Chief Materials Engineer, Central Materials Laboratory of the Ministry responsible for Works or other approved laboratory for testing.

The priming, undercoats and finishing coats shall each be of different tints and the priming and undercoat shall be the correct brands and tints to suit the respective finishing coats, in accordance with the Manufacturer's instructions. All finishing coats shall be of colours and tints selected by the Project Manager.

Each coat shall be properly dry and in the case of oil or enamel paints shall be well rubbed down with fine glass paper before the next coat is applied. The paintwork shall be finished smooth and free from brush marks.

Colour cards of all paints, etc., shall be submitted to and samples prepared for approval of the Project Manager before laying on, and such samples, when approved, shall become the standard for the work.

All paints, emulsion paints, and distempers shall be applied by means of a brush or spray gun or rollers of an approved type, where so agreed by the Project Manager.

No painting is to be done in wet weather or on surfaces which are not thoroughly dry.

### 13.10 Preparation

All surfaces to be painted shall be entirely free from all dirt, grease and dust.

(i) Plaster

Areas of defective plaster shall be cut out and made good with similar plaster finished smooth.

Large cracks shall be cut out, under cut and filled with plaster finished smooth and flush. Small cracks and holes shall be filled with an approved hard filler.

Plastered surfaces to be painted with oil paint shall be treated with one coat of alkali resistant primer.

(ii) Metal

All rust and loose scale is to be removed by means of wire brushing or scraping.

All bare metal is to be primed with a primer conforming to BS 2523 and all bare patches of works priming shall be touched up and brought forward.

Coated surfaces, such as stack pipes shall be thoroughly brushed down and painted with one coat of knotting.

Galvanised surfaces to be washed down, after drying shall be coated with an approved solution approved by the Project Manager.

## (iii) Woodwork

All woodwork shall be rubbed down, all knots covered with a thick coat of good shellac knotting, given one coat of approved ready-mixed proprietary wood primer and all cracks, nail holes, defects and uneven surfaces etc., stopped and faced up with hard stopping rubbed down flush.

## (iv) Insulation or Fibre Boards

All holes shall be stopped with an approved plaster compound rubbed down flush and all surfaces treated with one coat of thinned paint or emulsion paint as specified.

### 13.11 Preparation of Existing surfaces

The preparation of existing surfaces shall comprise the following activities:

- (i) Plaster, Insulation Board and remove all loose flaking wash down, rub down, paint fill in holes and cracks with an approved filler including cutting out cracks in old plasterwork, bring forward bare patches.
- (ii) Metal - Wash down, rub down, thoroughly scrape down as necessary to remove all loose and flaking paint and rust and prime and bring forward bare patches.
- (iii) Woodwork - Wash down, rub down remove all loose and flaking paints fill in cracks and holes etc. with an approved filler and knot and prime and bring forward bare patches. Alternatively where specified completely remove paint by burning off or other approved means, rub down, fill in cracks and holes etc. with an approved filler and knot and prime as described for new woodwork.

### 13.12 Backs of Frames

Prime backs of all timber frames, skirtings and the like in contact with masonry or plaster with one coat of approved ready mixed proprietary wood priming paint before fixing.

### 13.13 Remove Ironmongery

Metal fittings and fastenings etc., are not to be fixed until painting is completed. Where they have been fixed, they shall be removed and stored until painting is completed and then carefully cleaned and refixed in position. Lugs to metal windows and door handles shall be painted before glazing.

### 13.14 Cover up and Protect

Before painting is commenced, floors must be washed and the buildings thoroughly cleaned out and every precaution taken to keep down dust.

The Contractor shall provide covers to all gauze screens and sashes and elsewhere as may be required to prevent marking and staining by paint.

### **13.15 Cleaning up**

Replace any cracked or broken glass. Remove and replace any gauze screens which may be stained with paint. Remove all other paint splashes, spots and stains and clean out and leave the buildings to the requirements and satisfaction of the Project Manager.

## **14.0 FIRE EXTINGUISHERS, CABINETS, pumps and ACCESSORIES**

### **14.1 Fire extinguisher cabinets**

All fixed recessed and semi-recessed hose reel cabinets and/or surface-mounted cabinets have a heavy gauge, steel or aluminum box and shall be located installed in accordance with BS EN 671-1.

### **14.2 Fire extinguishers**

Fixed fire extinguishing installations and equipment on premises shall be located and installed in accordance with BS EN 671-1. Portable fire extinguishing shall be in accordance with BS 5306-3.

### **14.3 Accessories**

All accessories, fire blankets and brackets shall meet the requirements of 02/121662, 02/121663, 02/121665, 02/121667, 02/121668, 02/121669, 02/121670 and 02/121672.

### **14.4 Pumps**

Fire Hosereel pumps shall consist of a duplicate set of end-suction centrifugal pumps, each pump rated for 2.27 litres per second flow producing a minimum head to all hosereels of 25 metres and one number diesel engine driven centrifugal pump, pressure vessel, valves and accessories.

Each pump shall be supplied complete with an electric motor, base plate, anti-vibration mountings, gate valve on suction port and ate plus non-return valve on the discharge port.

The common suction pipe to the duplicate pumps set shall be fitted with an in-line strainer to BS 5154, generally as Crane type D 287 and foot valve strainer.

The fire hosereel pump shall be controlled by a pressure switch and tank to maintain the required minimum pressure head.

Pumps motors contactors, neon run-fail lamps, duty/stand-by automatic change-over switch and local isolator for the fire hosereels installation to be supplied and installed under this item shall be housed in a proprietary control panel. A bypass shall be constructed for the pumps.

## 14.5 Hosereel Installation

### i) Pipes and Pipe Fittings

Pipes shall be galvanised steel tubing to BS 1387:1967 Class C with pipe threads to BS 21.

Pipe Fittings shall be Wrought steel seamless pipe fitting to BS 1740 Part 1: 1971.

### ii) Valves

Non-return Valves: lift type with bronze body and composition disk conforming to BS 5154 and generally as Crane type DM 118.

Gate Valves shall be bronze body and solid wedge disk having non-rising stem and wheel conforming to BS 5154 and generally as Crane type DM 160.\

### iii) Hosereels

Hosereels shall be recessed, swinging, automatic type with 30 metres long x 25mm diameter hose and nylon spray/jet/shut-off nozzle conforming with BS 3169:1981

Each hosereel shall be fitted with a screw down bronze globe valve to the requirements of BS 5154 on the inlet to the reel.

## 15. EXTERNAL WORKS

### 15.1 Standards

The requirements of the following British Standards shall be observed:-

#### British Standards

- a). B.S. 1621 Bitumen Macadam (with crushed rock or slag aggregate)
- b). B.S. 340 Precast concrete kerbs, channels, edgings and quadrants
- c) B.S. 368 Precast concrete flags
- d) B.S. 4428 General landscape operations (excluding hard surfaces)
- e) B.S. 3882 Recommendations and classifications for top soil
- f) B.S. 3936 Nursery stock
- g) B.S. 3998 Recommendations of treework
- h) NOTE Preambles to preceding trades where applicable shall apply equally to the work contained herein

### 15.2 Generally

#### 15.2.1 Standard specification

In case where no particular specification or standard is given for any article or material to be used in the Contract, the relevant Specification of the British Standards institution or other relevant standard shall apply unless otherwise stated.

#### 15.2.2 Submission of samples

As soon as possible after the Contract has been awarded, the Contractor shall submit to the Architect a list of the suppliers from whom he proposes to purchase the materials necessary for the execution of the works. Each supplier must be willing to admit the Architect, or his representative to this premises during ordinary working hours for the purpose of obtaining samples of the materials in question. Alternatively, if desired by the Architect, the Contractor shall deliver the samples of materials to be used as aggregates, shall be taken and tested in accordance with the provisions of British Standard 812: Sampling and Testing of Mineral Aggregates, sands and Fillers. Subsequent supplies shall conform, within the specified tolerances, to the quality of approved samples.

The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no source of supply shall be changed without the Architect's prior approval.



Samples of materials approved will be retained at the Architect's office until the completion of the Contract. Samples may test to destruction.

All materials delivered to site must be at least equal in all respects to approved samples.

### 15.2.3 Manufacturer's Certificates

The Contractor shall, whenever required obtain from the manufacturer and submit to the Architect, certificates showing that tests of materials have been carried out in accordance with the requirements of the relevant British Standards, or other approved Standards, or with the requirements of this Specification.

No payment will be made in respect of any costs incurred by the Contractor or by the manufacturers in connection with tests required by this clause or for supplying test certificates in respect thereof.

### 15.2.4 Rejected materials

Should any materials or articles manufactured on or off the site be, in the of the judgement Architect, of inferior quality, or damaged in any way as to make it unsuited for the work, then such materials or articles shall not be used on the works and shall be removed and replaced, all at the Contractor's expense and in each case as the Architect shall decide and direct.

### 15.2.5 Building stone

All building stone shall be capable of withstanding when wet a crushing stress of 1.4kg/sq.mm. The source shall be approved by the Architect and stone supplied there shall be free from magadi, overburden, mudstone, cracks sandholes, veins laminations or other imperfections. The stone shall be chisel-dressed into true rectangular blocks, with each surface even and at right angles to all adjoining surfaces, to the size specified. For exposed stonework the maximum permissible variation of any of the specified dimensions shall be 6mm provided that cut stone, supplied as rock face stone may be hammer dressed on one face only, or on the face and one end, if in other respects it conforms with this specification. Stone shorter than 75mm will not be accepted.

Unless the Architect allows otherwise the Contractor shall at his own expense provide and dress for 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with B.S. 1438: media for Biological percolating filters, Appendix B, (sodium sulphate soundness test) except that:

- a). The treatment shall be repeated for 10 cycles only ; and
- b). The second criterion of failure shall be amended to allow for a loss of weight of not more than 20% of its original weight.

### 15.2.6 Stone dust

Stone dust for blinding shall be blacktrap screened to the following grading:-

a).	Passing	10mm	sieve	100%
b)	Passing	No. 4	sieve	85% - 100%
c)	Passing	No. 100	sieve	5% - 25%

## 15.3 Site Clearance and Earthworks

### 15.3.1 Levels to be agreed in advance

Prior to any site clearance, the Contractor shall satisfy himself that the existing ground levels as indicated on the Drawings or schedules of longitudinal or cross section levels are correct. Should the Contractor wish to dispute any levels he shall submit to the Architect a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the Architect's decision as to the correct levels is given. If the Contractor fails to take the requisite levels, the ground levels shown on the Drawings and sections or as determined by the Architect shall be taken as correct.

### 15.3.2 Clearing

Prior to commencement of any earthworks, the Contractor shall clear the area of the Site indicated on the Drawings, unless otherwise directed by the Architect. He shall also, at times required or approved by the Architect, clear the site over the area of stockpiles, road junctions, lines of ditches or drains and such areas as the Architect may require.

All surface objects and all trees, hedges, scrub, undergrowth, stumps and tree roots, not designated to remain, shall be cleared and/or grubbed.

Materials and debris which cannot be burnt shall be carted to tips provided by the Contractor or otherwise disposed of to the satisfaction of the Architect.

### 15.3.3 Removal of topsoil roots and grass

Topsoil, roots and grass shall be stripped in a separate operation from clearing.

Unless otherwise directed by the Architect, topsoil, roots and grass shall not be stripped over the full area of the site, but only over the area affected by the earthworks.

### 15.3.4 Dust

The Contractor shall implement measures to control dust, by periodically spraying the works with water.

The Contractor shall take all necessary precautions against the growth on the site of weeds and shall remove them as necessary throughout the period of works and maintenance.

### 15.3.5 Earthworks limits

The Contractor shall restrict his workings to the limits described in the Contract, unless otherwise approved by the Architect.

**15.3.6 Definitions**

- Fill-material : "Fill-material" shall mean material deposited in accordance specifications from any of the classes specified in clause W.9 in order to build up an earthworks construction to formation level as shown on the Drawings or as ordered by the Architect.
- Spoil-material : "Spoil-material" shall mean material deposited in accordance with these specifications from any of the classes specified in clause W.9 and which, being obtained from "cut" is unsuitable surplus to the requirements of the works.
- Sub-grade : "Sub-grade" shall mean the upper layer(s) of material, either insitu or infill. Where there is no improved sub-grade, the top of the sub-grade is at formation level. When an improved sub-grade is placed, the top of the improved sub-grade is then considered as the formation level. In this section, unless otherwise specified, "sub-grade" shall mean the upper 300mm of earthworks (compacted thickness), either in-situ or infill.
- Improved sub-grade : "Improved sub-grade" shall mean the layer(s) of selected infill material, the top of which is at formation level, placed where the natural in-situ or fill-material is, in the opinion of the Architect, unsuitable for the direct support of the pavement. The material for sub-grade shall be obtained from borrow areas. The thickness of an improved sub-grade shall be at least 150mm.

**15.3.7 Classification of excavated material**

Excavation will be paid for separately for the following three classes of material:-

- a). Class 1 : Hard material (or rock) : This class shall include all material which, in the opinion of the Architect, either:-
- i) requires blasting for its removal or,
  - ii) requires the use of metal wedges and sledge hammers for its removal, or
  - iii) requires the use of compressed air drilling for its removal or,
  - iv) is such that, when worked with a tractor of at least 200kw (270 flywheel h.p.), fitted with a rearmounted heavy-duty hydraulic single tine of 100mm maximum width, the tine penetrates to a depth less than 75mm.
- b). Individual boulder greater than 1C.M. in volume shall be included in this class when their nature and size are such that, in the opinion of the Architect they cannot be removed without recourse to one of the above methods.

- c). Where a portion of excavation contains 50% or more by volume of boulders of this order, such portion shall be considered as class 1 material throughout.
- d) Class 11 :Medium-hard material (or rippable) : This class shall include all material such as consolidated gravel, weathered or stratified rock, stones or boulders less than 1 C.M. in volume, which, in the opinion of the Architect:-
  - i) Can be extracted without recourse to the methods specified for class 1 material, but
  - ii) requires ripping for its removal, or
  - iii) in confined spaces, requires hand-excavation using compressor tools for its removal.
- e) Provided all reasonable steps have been take to the satisfaction of the Architect, to facilitate the removal of the material by other methods.
- f) Class 111: Normal Material: This class shall include all material which does not require recourse to the methods for class 1 and 11 materials.

#### 15.3.8 Excavation

Over excavation: Any excess excavation shall be made good at the Contractor's own expense by backfilling with approved "base" material, deposited and compacted as specified.

Where slopes in rock are excavated in excess the tolerance specified shall be reinstated in class 25 reinforced concrete all suitably bolted to the rock face as directed by the Architect at the Contractor's own expense.

Excavation below embankments and below formation level: where any material below the natural ground level under embankments or below formation level in cuttings is required to be excavated, it shall be removed to such depth and over such areas as shown on the Drawings or as directed by the Architect. The resultant excavation shall be backfilled with an approved material deposited and compacted as specified for the forming of embankments and sub-grade.

If, after the removal of material as specified in the above paragraph, the Contractor allows the material exposed to reach a condition where compaction of back-filling is impracticable, he shall make good at his own expense, either by additional excavation and backfilling or by other measures.

#### 15.3.9 Stockpile areas

The Contractor shall obtain the approval of the Architect to the sitting of the stockpiling areas.

No material shall be stockpiled without the consent of the Architect. The Contractor shall give the Architect at least 24 hours notice of his intention to stockpile. Stockpile areas shall be chosen and prepared and all stockpile material shall be deposited in such a way as to

facilitate subsequent measurement of stockpile volume and in all instances shall be to the satisfaction of the Architect.

### 15.3.10 Construction of embankments and fills

**General:** All embankments and fills shall be formed and completed to the correct lines, slopes, widths and levels shown on the Drawings.

Where shown on the Drawings or directed by the Architect, shoulders and beam shall be constructed as part of the earthworks operation and paid for as such.

Unless otherwise specified, where an embankment of less than 1m below formation level is to be made, topsoil and all vegetable matter shall be removed from the surface upon which the embankment is to be placed and the cleared surface shall be completely broken up by ploughing or scarifying to a minimum depth of 150mm. This area shall then be compacted to a dry density of at least 95% MDD (Standard Compaction).

**Unsuitable material:** Embankments and fills shall be constructed only of material approved by the Architect, obtained from the excavations of cuttings, ditches and borrow-areas.

Materials with high swelling characteristics or high organic matter content and any other undesirable material shall not be used, unless specifically directed by the Architect. Unsuitable material shall include:-

- a) All material containing more than 5% by weight, of organic matter (such as topsoil, material from swamps, peat, loggs, stumps and perishable material)
- b) All material with a swell of more than 3% (such as black cotton soil).
- c) All clay of liquid limit exceeding 80 or plasticity index exceeding 50.
- d) Materials having moisture content greater than the maximum permitted for such materials.

**15.3.11 Rock-fill:** "Rock-fill" shall consist predominantly of class 1 material of such size that the material can be placed only in layers of compacted thickness exceeding 300mm.

Unless otherwise directed by the Architect, stones and boulders greater than 0.2 C.M. in volume (average size: 600mm) shall not be used for the construction of embankments and fills.

**Selection of materials for the upper layers:** The Architect may direct the certain materials to be excluded from the sub-grade (see clause W.15) or from the upper layers of fill. He may also direct that other materials be set apart or obtained from borrow and used only for these layers. The Contractor shall then comply with the Architect's directions and shall allow in his rates for such selection of materials.

Rock-fill shall not be placed less than 600mm below formation level.

**15.3.12 Laying of Compaction:** Where material other rock-fill is used for the construction of embankments and fills, it shall be placed in layers of compacted thickness not exceeding 300mm, unless otherwise directed by the Architect. The layers shall be parallel to the top of sub-grade level and cross-section.

Unless otherwise specified, the layers of fill material shall be compacted throughout to a dry density of at least 95% MDD (Standard Compaction), except for the upper 300mm (sub-grade) which shall be compacted to a dry density of at least 100% MDD (Standard Compaction).

The moisture contents of the material shall be adjusted so that the above minimum compactions are obtained. Unless otherwise accepted by the Architect, the moisture contents at the time of compaction shall not exceed 105% of the optimum moisture content (Standard Compaction). Where water needs to be added, it shall be applied in an even manner and the rate of application shall be such that no transverse or longitudinal flow occurs.

Where rock is used a filling, the rock shall be placed in the bottom of the embankment or as directed by the Architect. The largest portions of rock shall be placed in layers of maximum compacted thickness of 1m. The interstices shall be filled with spalls and finer material approved by the Architect. The whole layer shall be material approved method, until the interstices are completely filled and until the specified compaction is obtained.

### **15.3.13 Drainage of works**

All cuttings and embankments shall be kept free of standing water and drained during the whole of the construction.

Should water accumulate on any part of the earthwork either during construction or after construction the Contractor shall remove and replace at his own expense any material, which in the opinion of the Architect, has been adversely affected.

The Contractor shall so order his construction programme that the construction of culverts and drains does not lag behind the earthworks. Well in advance of commencing the earth-moving operations over swampy or waterlogged areas, the Contractor shall cut drains and ditches and carry out any other works as necessary to assist in draining the ground.

All drains and ditches shall be maintained in proper working order throughout the duration of the Contract.

The Contractor shall allow in his rates for draining the earthworks satisfactorily at all stages during the construction and arrange his methods and order of working accordingly.

He shall provide within the site where necessary temporary water-courses, ditches drains, pumping or other means of maintaining the earthworks free from standing water. Water discharged from the site shall not be run into a road but be carried direct to an approved sewer, ditch or river through troughs, shutes or pipes.

Such provision shall include carrying out the work of forming the cuttings and embankments in such a manner that their surfaces have at all times a sufficient minimum crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

In pumping out excavations and in any lowering of the water table the Contractor shall pay due regard to the stability of all structures.

#### **15.3.14 Side ditches**

Side ditches, considered as earthworks and measured and paid for as such, shall be shaped by excavating to the lines, slope and widths shown upon the Drawings and finished off so that the sub-grade levels and Camber or super-elevation of the of the sub-grade level and cross fall of the shoulders and slope and invert levels of the side ditches are everywhere in accordance with the Drawings or as directed by the Architect.

#### **15.3.15 Sub-grade and improved sub-grade**

Unless otherwise specified or directed by the Architect, materials forming the direct support of the pavement shall comply with the following requirements:-

- a) CBR (100% BS - 4 days soak) : Minimum 5%
- b) Swell (100% BS - 4 days soak) : Maximum 2%
- c) Organic matter (percentage by weight) : maximum 3%

Where, in the opinion of the Engineer, material unsuitable for the direct support of the pavement occurs in cuttings, the Contractor shall excavate it to the depths and widths directed and replace it with selected fill material to form an improved subgrade. The work will be paid for at the appropriate rates of "spoil" and "fill" and no additional payment will be made.

#### **15.3.16 Laying and compaction:**

The maximum compacted thickness which shall be laid, processed and compacted at one time shall be 300mm.

The layer shall be clarified, water shall be uniformly mixed in or the material allowed to dry out to the correct moisture content.

The upper 300mm of the earthworks (that is to the sub grade) shall be compacted to a dry density of at least 100% MDD (Standard Compaction) in cuttings where there is no improved sub grade and everywhere in fills and embankments.

In cuttings where an improved subgrade is to be placed, the upper 150mm of the subgrade prior to the placing of the improved subgrade layer(s), shall be compacted to at least 100% MDD (Standard Compaction), unless otherwise specified.

All improved subgrade shall be compacted to a dry density at least 100% MDD (Standard Compaction) for its full depth.

The moisture content shall be adjusted in order that the above minimum Compactions are obtained. Unless otherwise accepted by the Engineer, the moisture content at the time of compaction shall not exceed 105% of the optimum Moisture Content (BS).

Top of subgrade (including improved subgrade) : During the above process, the surface of each subgrade layer shall be graded to level, parallel to the crossfall and camber and profile shown upon the Drawings or directed by the Engineer and to the Tolerance specified.

The subgrade shall be cleaned of all foreign matter and way potholes, loose material ruts, corrugations, depressions or other defects which have appeared in the subgrade layer, due to improper drainage, traffic or any other cause, shall be corrected. If directed by the Engineer, the Contractor shall scarify, grade and recompact the subgrade to line, level and specification at his expense.

No work above the subgrade shall be executed until the subgrade has been inspection and approved by the Engineer.

## 15.4 Construction of Sub-Base and Bases

### 15.4.1 General

The term "gravel" used throughout this section shall be deemed to include; lateritic gravel, Quartzitic gravel, some forms of weathered rock, soft stone, coral rag and conglomerate.

A "grade" base will be made up of one of these natural gravels, or of sand or clay sand, or of a combination of these materials, without the addition of any stabilizing agent.

### 15.4.2 Material requirements

Unless otherwise specified or directed by the Engineer, the material shall comply with the following requirements:-

California bearing ratio:

- a) The material for base shall have CBR of least 80.
- b) The material for sub-base shall have a CBR of at least 30.
- c) Unless otherwise specified, the CBR shall be measured at a dry density corresponding to 95% MDD (heavy compaction) and after 4 days.

### 18.4.3 Requirements for gravel:

In addition to the CBR requirements, the gravel material shall comply with the following specification:-

Gravel for		Base	Sub-base
Plasticity Index	- Maximum	15	25
Loss Angels value	- Maximum	30	70
Aggregate Crushing value	- Maximum	35	75



## Grading:

The grading curve of the material, after processing compaction shall be a smooth curve within either of the following envelopes, as applicable:-

Sieve Size passing (mm)	Percentage by weight	
	Base	Sub-grade
80	-	100
63	-	95 - 100
50	100	90 - 100
40	95 - 100	85 - 100
28	80 - 100	72 - 100
20	60 - 100	55 - 100
10	35 - 90	30 - 100
5	20 - 75	18 - 85
2	12 - 50	10 - 65
1	10 - 40	8 - 52
0.425	7 - 33	7 - 43
0.075	4 - 20	4 - 35

## Clayey Sand:

In addition to the CBR requirement, the clayey sand for sub-base shall comply with the following specification:-

Percentage passing 2mm Sieve:	Maximum 95
Percentage passing 0.075 mm Sieve	Maximum 10 - Maximum 30
Uniformity coefficient:	Minimum 5
Plasticity Index	Minimum 5- Maximum 20

**15.4.4 Setting Out Sub-base to line and level**

The Contractor shall set out the road line and level at intervals of not more than 25 metres or such lesser intervals on horizontal and vertical curves as the Engineer may require, and sufficient to ensure that the levels of the sub-base are constructed within the specified tolerances and the minimum thickness ordered for the course. Reference pegs shall be provided clear off the road and at right angles to it from which the centre-line or level can be re-established at any time. These shall be maintained so long as they are needed by the Engineer to check the work.

All setting out shall be agreed by the Engineer before any sub-clause or base course work is commenced.

**15.4.5 Laying and compacting natural material sub-base and base**

The sub-base and base material shall be deposited in such quantity and spread in a uniform layer across the full width required, so that the final compacted thickness is nowhere less than shown upon the Drawings or ordered by the Engineer.

The compacted thickness of any layer laid, processed and compacted at one time shall not exceed 200mm and where a greater compacted thickness is required, the material shall be laid and processed in two or more layers.

The material shall be broken down so that the maximum size of any particle is not greater than specified. This may require a grid-cleator sheep-foot roller or a pulverizer and the Contractor shall allow for such processing in his rates.

Any oversize material which cannot be broken down to the required size shall be removed and disposed of as directed by the Engineer.

The layer shall then be scarified and water shall be uniformly mixed in, as directed by the Engineer. It shall be graded, Compacted to a dry density of at least 95% MDD (Heavy Compacted) and graded to final level.

The moisture content shall be adjusted so that the above minimum Compaction is obtained. Unless otherwise directed by the Engineer, the moisture content at the time of compaction shall be between 80 and 105% of the optimum Moisture Content (Heavy Compaction).

**15.4.6 Tolerances**

The Sub-base and base shall be constructed within the tolerance specified.

**15.4.7 Surface levels of flexible pavement course and concrete pavement**

The level of any point on the surface of each of the pavement course of the carriageway, the true level as specified, shall on completion of compaction, conform to that shown on the Drawings within the tolerances stated in column 3 of the following table.

Compliance with the requirement shall be checked, in respect of the surface of each course, either by levelling in relation to a survey Datum using pegs or pins, or if raised or flush kerbs or concrete marginal haunches, concrete form, rails or bankettes have been laid, by use of a template or stretched line, using a datum the top surface of the levelling device after the profile or level of the latter have been approved by the Engineer. All longitudinal profile devices shall be laid true to line and level each within a tolerance of +/- 3mm the tolerance in level being measured over 8 metres. If this tolerance is exceeded the level and alignment shall be corrected, if necessary, by lifting and relaying or resetting.

In case of the base course and wearing course of flexible surfacing, and the surface of concrete pavements, the finished surface, in addition to conforming to the limits of tolerance from the true surface levels as specified above, shall when tested with a 3 metre straight edge placed parallel to the center line of the road, have no

depression greater than the appropriate one stated in the following table:-

Measurements of level of tolerances shall be made while the material is still warm and rectification where necessary, carried out immediately; otherwise the Engineer may require the whole area involved to be removed to the full depth of the layer and reconstructed with fresh material.

Tolerance from Surface	true surface level	Maximum Depression tested with 3m straight edge placed on the surface parallel to the center line of carriageway
Sub-grade	+0-50mm	-

## 15.5 Drive Ways and Parking Areas

### 15.5.1 Excavations

Excavations to areas to receive bitumen macadam or other road or paved finish shall be carried out in a manner ensuring that excavations plant and vehicles do not cause shear failure more than 250mm in the sub-grade. Wheel loads and tyre pressures shall be limited and work shall be interrupted to let the sub-grade dry out as necessary to avoid such sub-grade failure.

If shear failure more than 250mm deep occurs in the sub-grade, the soil affected shall be excavated and replaced by soil filling as described.

If the soil develops highly elastic conditions as excavation approaches formation level, excavations shall be interrupted until the excess pore consequently disappears.

Before any further work is executed the formation level must be inspected and approved by the Engineer.

### 15.5.2 Compaction

The sub-grade shall be compacted by a smooth-wheeled roller of 8 to 10 tonnes weight or vibrating roller of minimum 1,300kg., or other approved plant. The number of coverages shall be at least 10 and there shall be a 50% overlap of successive coverages. If so instructed by the Engineer, water shall be added during compaction to obtain optimum water content. Filling shall be compacted as above but in maximum 200mm deep layers.

### 15.5.3 Sub-grade surface finish

The surface of the sub-grade shall be finished to the levels, falls and crossfalls shown on the Drawings within the following tolerances:-

- i.) The level shall not be above and not more than 50mm below the level shown on the Drawings.

- ii.) The falls shall be within 10% of the falls shown on the Drawings.
- iii.) The smoothness shall be such that departures from a 3 meter straight edge laid in any direction shall not exceed 50mm and there shall be no ponding of water.

#### 15.5.4 Coarse Aggregate

Coarse aggregate for the base shall be crushed stone or rock confirming to the following requirements:-

#### 15.5.5 Sub-base

The material for use in the sub-base shall consist of crusher dust as described, or other approved material. It shall be placed in one layer of such thickness that when compacted it shall attain the finished thickness shown on the Drawings. The material shall be watered as necessary and compacted as described. The sub-base material shall have a CBR value (soaked) for not less than 25.

#### 15.5.6 Base

The material for use in the basecourse shall consist of one layer of coarse aggregate as described of which the interstices are filled with fine material consisting either of crusher dust or a mixture of crusher fines. The proportions of crusher dust and crusher fines in the fine material shall be such as to obtain the maximum density of base course when compacted.

The procedure for construction shall be as follows: The coarse aggregate shall be placed in a layer of such thickness so as to obtain the required thickness after compaction. It shall then be compacted lightly until the Engineer is satisfied that a layer true to shape and level has been obtained. The fine material shall then be spread over the layer by hand mechanical means. The application of fine material shall be made gradually in successive layers not exceeding 25mm in thickness and each be worked into the voids in the coarse aggregate before the application of the succeeding layer. The fine material shall be laid as described and brushed into the coarse aggregate and rolled and consolidated by an approved vibrating roller feed to the bottom of the layer.

Final compaction shall be by an 8-10 tonnes smooth-wheeled roller until there is no visible movement under the action of the roller and until the required tolerances are achieved. Water may be applied during final compaction subject to the Engineer's approval.

Compaction shall in any case achieve 100% maximum dry density in accordance with B.S. 1377.

#### 15.5.7 Quarry waste

Quarry waste shall mean material to the same specification as crusher dust, except as follows:- ii). The material may have up to 35% of stones not larger than 38mm provided that the material passing the 5mm sieve is within the limits specified.

Quarry waste shall be clean and completely free from earth, organic or other foreign matter.

- i). The plasticity index taken on material passing the No. 36 sieve shall not exceed 16%

#### 15.5.8 Basecourse finish

The surface of the base course shall be finished to the levels, falls and crossfalls shown on the Drawings subject to the following.

- i.) The level shall be within + or - 12mm of the levels shown on the Drawings.
- ii.) The falls shall be within 19% of the falls shown on the Drawings.
- iii.) The smoothness shall be such that departures from a 3 metre straight edge laid in any direction shall not exceed 12mm..

The surface of the basecourse shall be inspected and approved by the Engineer before bitumen paving is commenced.

Immediately before applying the priming coat, the surface of the basecourse shall be brushed free from dust and loose stones. The material for the priming coat shall be a cutback of M.C.O. grade or other approved.

Approximately 30 minutes before applying the priming coat the surface of the basecourse should be made slightly damp by use of a water spray.

The priming coat shall be applied at a temperature of 100-150 degrees Fahrenheit at a rate of 0.60 litres per square meter.

After application of the primer graded premix of 30mm to 40mm compacted thickness shall be used, with a seal coat.

#### 15.5.9 Bitumen macadam surfacing

A single course open graded premix of 30mm to 40mm compacted thickness shall be used, with a seal coat.

Course aggregate shall be crushed blacktrap with particles having a cubicle shape to the Engineer's approval and shall be washed free from dust.

The Coarse aggregate gradings shall be:-

Sieve Size	Percentage passing
19 mm	100
13 mm	60 - 100
10 mm	45 - 70
6 mm	30 - 50
4 mm	25 - 40
8 mm	15 - 25
200 mm	2 - 5

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The binder shall be shellmac MC/RC2 or other approved. The percentage by weight of binder shall be 4.5%. Mixing shall be in an approved mixer and mixing shall proceed until the stone is evenly coated with binder. The temperature (at mixing) shall be within the following range:-

	Binder	Aggregate		
150° F	Mixing Temperature	50°	95° F	125° -

The laying temperature shall be not less than 20° F below the mixing temperature.

The mix shall be spread evenly over the primed surface and shall be thoroughly compacted by rolling with a minimum of 6 passes. A smooth-wheeled roller of not less than 5 tonnes weight and with rear wheel loading of 0.25 kg per square millimeter width shall be used.

#### 15.5.10 Rolling

Any longitudinal joints shall be rolled first, after which rolling shall start longitudinally at the side and proceed towards the center of the carpet. Each pass of the roller shall overlap the preceding one by at least one half width of the rear wheel. Alternate passes of the roller shall be of varying length. Immediately following initial compaction, the surface shall be checked with a straight edge to ensure that it meets the surface finish requirements. Minor variations shall be corrected by rolling, but major imperfections shall be compacted by adding or taking away mix while it is still workable.

#### 15.5.11 Surface finish

The surface of the bitumen macadam shall be finished to the levels, contours and slopes shown on the Drawings with the following tolerances:-

- i). The level shall be within + or - 6mm. of the level shown on the drawings.
- ii). The gradient shall be within 10% of the gradient shown on the drawings.
- iii). The smoothness shall be such that departures from a 3 metre straight edge laid in any direction shall not exceed 6mm.

#### 15.5.12 Seal coat

The seal coat shall consist of precoated fines consisting of crushed blackstrap stone graded from 3mm to dust, or coarse sand. The binder shall consist of 4.5% by weight of MC/RC2. The seal coat shall be spread and brushed into the macadam surface at the rate of

180 square metres per tonne and compacted by rolling as for the macadam.

# **PART 2**

# **BUILDING SANITATION**



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## 1.0 PLUMBING

### 1.1 Statutory Requirements

All plumbing work, pipework and sanitary installations shall be carried out in accordance with the Regulations of the National Water and Sewerage Corporation or other Local Water Authority. Where no such Authority exists, then such work shall be carried out in accordance with the directions of the Project Manager.

### 1.2 Galvanised Steel Pipes and Fittings

Galvanised Steel Pipes shall comply with BS 1387 Class 'B' except where the Water Authority requires otherwise.

Fittings shall be galvanized malleable iron to BS 143 and BS 1256.

All pipes and fittings shall be obtained from an approved manufacturer.

Galvanised steel water tubes shall have screwed and socketted joints put together with ties and red leads and fixed to walls with approved patten clips spaced at not more than 1750 mm apart. Made-bends shall be formed cold and shall wherever possible be used in preference to elbows. Elbows shall be of the round kind where possible unless otherwise specified, pipes shall be fixed in chases in walls. Where pipes are required to be fixed to the wall surfaces, they shall be fixed with approved holder-bats 25 mm clear of the finished wall surface.

### 1.3 PPR pipes and fittings

The PPR pipes and fittings shall be produced from polypropylene Random type PN25 material or equivalent which has high molecular weight and excellent creep resistance.

The installation shall be in accordance with the manufacturers recommendation with provision for expansion, including all necessary fittings and accessories. The pipe shall be tested at 15 bars for one hour, immediately after the preliminary test, the main test shall be carried out at 10bars for 24 Hours. There shall be no leakage of any kind not even in the form of moisture in either of the tests. The installation must be perfectly tight.

## 1.4 Cast Iron Soil, Waste and Vent Pipes

Coated cast iron soil waste and vent pipes and fittings shall be of a medium quality to comply with BS 416 with ears cast on and shall be obtained from an approved manufacturer.

Pipes shall have spigot and socketted joints with a tarred hempen gasket rammed down the sockets and lead wool well caulked in, and shall be fixed to walls with clout rose-headed nails and 38 mm gas barrel distance pieces and hardwood plugs built into the wall. All junctions and bends on exposed cast iron soil and waste pipes shall be fitted with access doors and screwed inspection eyes. The top end of all vent pipes shall be fitted with a galvanized domical wire grating covered with 32 S.W.G. x 20 Mesh copper wire mosquito gauze.

### 1.4.1 uP.V.C. Soil Systems

u. P.V.C soil pipe and fittings shall be supplied and fixed as indicated on the drawings and Schedules.

The pipes and fittings shall comply in all respects to British Standard 4514 and shall where appropriate bear the British Standard Kite Mark as Terrain Manufacture or equal and approved.

## 1.5 Tubing Generally

All pipes shall whenever possible be located in such a manner as to minimize risk of mechanical damage and shall be readily accessible for inspection and repair, but shall nevertheless not appear unsightly.

All waste pipes shall be fitted with sweep-tees with screwed cleaning caps at each change of direction. All services shall be connected to sanitary fittings, tanks, etc. with approved union connectors. The exposed ends of all overflow pipes shall be mosquito-proofed by means of 32 S.W.G x 20 mesh copper wire gauze, tightly bound on with stout wire.

## 1.6 Water Service and Distribution Pipework

Service pipes shall be laid from the stop-valves at the boundary of the site to a storage tank; stop-valves being inserted in all positions as required by the Project Manager and all pipe work inside the building shall be securely fixed in position.

## 1.7 Branches to Drinking Water Draw-off Taps

Branches to drinking water draw-off taps shall be taken directly from the service pipe to drinking water draw off points in the building.

## 1.8. Delivery Pipes

Delivery on distribution pipes shall be fitted with stop valves and shall be taken from the storage cistern to feed draw-off taps over baths, lavatory basins, water closet flushing cisterns, etc. and the hot water system.

## 1.9 Running, Jointing and Fixing Pipes

Branches taken from vertical services and delivery pipes shall have a slight rise or fall as the case may require for the release of air to cisterns or taps and to enable the system to be drained. Pipe runs shall be set out to avoid traps and air locks.

Cold water piping shall not run in close proximity to hot water services. Where this cannot be avoided then both hot and cold water pipes shall be lagged.

## 1.10 Stops, Taps and Ball Valves

Stop-valves shall be provided and fixed on the service pipes at the entry to the buildings, at entry to water storage cisterns and on the delivery pipes close to water storage cisterns. Bib-taps shall be provided to the direction and approval of the Project Manager and shall be marked 'hot' and 'cold'

All ball valves shall comply with BS 1212 and all copper float balls shall comply with BS 1968. Brass taps and valves shall comply with BS 1010- 2.

## 1.11 Storage Cisterns

Storage tanks or cisterns shall be provided where shown. All storage cisterns shall be provided with galvanized mild-steel covers with rim turned down not less than 50 mm. The covers shall exclude entry of dust, debris, mosquitoes and vermin.

Storage cisterns shall have overflow pipes the cross section area of which shall not be less than 50% in excess of that of the supply pipe and shall be fixed at a height of not less than 25 mm above top water level, but below ball-valve inlet and shall be arranged to discharge externally. The outlet end of the overflow pipes shall be fitted with 32 S.W.G. x 20 mesh copper wire gauze of other approved material to prevent entry of mosquitoes and vermin. Ball valves shall be provided and fixed to cisterns at a distance not less than 50 mm above the top of the overflow pipe.

There shall be uPVC tanks 4NO. of 5,000L capacities complete with provisions for overflow, mains supply, connection float valve.

## 1.12. Testing of Water Mains and Services

The service pipe from the Water Authority's main to the storage tank and all other terminal points inside the building shall be tested at a hydraulic pressure of not less than twice the working pressure in the Water Authority's main and the same pressure shall be maintained without drop and without further pumping for a period of not less than thirty minutes. The down service pipes from the storage tanks to the various fittings shall be tested throughout to a pressure specified by the Water Authority.

## 1.13 Sanitary Fittings General

All sanitary fittings shall be made of hard, smooth, non-absorbent and in corrodible material conforming to the latest Uganda Standards or BS.

All fittings shall be fitted with traps with approved seals and where the trap is not an integral part of the fitting, a separate trap shall be connected between

the fitting and the pipe. Separate traps shall be made of cast iron, galvanized iron lead, brass or copper and shall have a minimum seal of 35 mm and shall be fitted with a screwed cleaning-eye.

### **1.14 Water Closets**

All water-closet suits shall be of approved material and shall comprise a flushing cistern and a pan are made to work together as a system and shall not be made up of pans and cisterns unsuitably selected.

Water closet pans shall be fixed to floors with large-gauge gunmetal screws and approved proprietary wall plugs. The brackets for water-waste preventer cistern shall be built into walls or secured with screws and approved proprietary wall plugs, and where cisterns are supported by lugs these shall be fixed by screws and proprietary wall plugs.

Water-waste preventers for high-level suites shall be set with the top of each cistern 2.15m above floor level.

### **1.15 Urinals**

Urinals shall consist of glazed fireclay urinals, stalls, slab or bowl types. Slab or stall types shall not be less than 1.1m high and shall be fitted immediately above the edge of a glazed half round channel not less than 100 mm internal diameter and laid to a fall of not less than 1 in 40. such channel shall discharge into a salt-glazed ware or virtuous enameled trap with a water seal of not less than 50 mm in depth. Traps shall have an internal diameter of not less than 50 mm for a single stall or bowl and not less than 75 mm for a range of stalls or bowls.

Channel shall be provided with approved lead traps with removable cast gunmetal domical gratings.

### **1.16 Baths, Lavatory Basins and Sinks**

Baths, lavatory basins, sinks etc shall be of approved material and shall be provided complete with all fittings and accessories.

Lavatory basins or sinks shall be supported on suitable brackets which shall be built 115 mm into walls or fixed with heavy screws and approved proprietary wall plugs.

## 2.0 DRAIN LAYING

### 2.1 Drainage & Sanitation Rules

All drainage work is to be carried out in accordance with the Uganda Code for Sanitary Installations in Buildings

### 2.2 Excavation

Excavation shall be made for manholes, lines of pipe and other works to the depth as shown on the Drawings, or as shall be required by the Project Manager or as necessary to permit proper execution of the work, should there be erroneous over-excavation to levels below those required for drains, foundations or other works, refilling and making up of levels shall be carried out in concrete of approved mix and no other material shall be used for this purpose.

All excavations shall be kept clear of water or mud by approved means. Sides of excavations shall be adequately supported by timbering or other means approved by the Project Manager.

### 2.3 Laying Lines of Pipes

The Contractor shall provide and fix properly painted sight rails which will be checked by the Project Manager before any pipes are laid, and there shall be no fewer than three sights rails in position at one time on every length of pipe under construction.

Boning rods shall be provided and wooden pegs driven into the bottom of the trench at required intervals, the top of each peg being set at the exact level of the proposed invert of the pipe. The alignment and level of each pipe laid must be tested by inserting the shoe of the boning rod.

### 2.4 Materials

The quality and description of all materials and appliances including pipes, cement, etc. used for construction or repair of any drain shall be approved by the Local Authority or the Project Manager.

### 2.5 Size of Pipe and Fall

Drains shall be of adequate internal diameters and shall be laid with falls that ensure a self-cleansing velocity viz (a velocity of flow of 0.76 m per second when the pipe is 25% full).

### 2.6 Minimum Cover to Pipes

Drains shall, whenever possible, have sufficient cover which shall, excepting cast iron and steel pipes, comply with the following table:-

Location	Minimum Cover (mm)
Streets	110
Carriage drives or yards used by light traffic	800
Elsewhere than mentioned above	500

## 2.7 Minimum Cover to Pipes other than cast Iron and Steel

Where in case of pipes other than cast iron and steel it is not possible to have the minimum cover such drains shall be entirely encased in concrete mix 1: 3: 6 not less than 150 mm in thickness all round the drain pipe.

## 2.8 Foundation for Drains

Drain pipes shall be laid with their barrels on a good, even, solid bed, free of irregularities. If so required by the Local Authority or the Project Manager, drain pipes shall be laid on an even bed of concrete or supported upon concrete piers spaced at approved intervals.

- (a) Pipes shall under no circumstances be laid supported by their sockets but a hole shall be cut in the bed to allow the socket to hang. Such socket holes shall be filled solid with earth or concrete after testing the pipes.
- (b) Pipes shall not be laid on temporary supports pending casting a concrete bed or filling the pipe. If a concrete bed is required, it shall be placed before the pipe is laid and where such pipe is laid on or in green concrete, such concrete shall be sufficiently firm not to allow any movement of the pipe.
- (c) If drain pipes of any material other than cast iron or steel are to be laid on made or unstable ground, such drain pipes shall be laid on beds of concrete mix 1: 3: 6 not less than 150 mm thick and the drain pipes shall be haunched with concrete mix 1: 3: 6 for the full width of the bed and to the crown of the pipe.
- (d) Where cast iron or steel drain pipes are to be laid on made or unstable ground, such drain pipes shall be supported on concrete (mix 1: 3: 6) bed not less than 500 mm wide by 150 mm thick and where necessary the bed shall be reinforced adequately. In case of pipes laid over and above ground surface, they shall be supported on concrete, steel or other approved piers spaced at not less than 2.75 m ( 8'0") centers on concrete foundations.

The piers shall have for securing the pipes, a cast iron, steel or other approved plate fixed on top and an inverted 'U' steel strap loosely around the pipe and with both ends firmly fixed into the top of the pier rollers and an expansion joint shall be used.

## 2.9. Drain Junctions

Every branch drain or tributary drain shall, at the point of junction join the main drain obliquely in the direction of the flow of the main drain and at half channel eight above the main channel. All bends and turnings shall be uniformly curved and any alteration in the size of the drain shall be properly tapered and of good shape.

## 2.10. Provision of Inspection Chambers

Appropriate inspection chambers shall be provided:

- a) at every point in a drain where two or more branch drains converge;
- b) at every point in a drain where there shall occur any angle, bend, deviation from a direct alignment, change in gradient, difference in level

or alteration in size; provided that pipe bends shall be allowed without inspection chambers for the connection of soil pipes, gullies, soil waste fittings to a drain, if such bends are surrounded by not less than 100 mm thick concrete mix 1: 3: 6

- c) at such points that no part of a drain shall be more than 15.25 m distant from the center of an inspection chamber without a rodding eye.

Provided that no connection or bend shall exceed 6 m in length measured from a gully trap, soil-pipe or soil-fitting, or the center of an inspection chamber without a rodding eye.

Provided further that in sewers exceeds 150 mm in diameter it shall be permissible to provide inspection chamber of manholes at such points that no part of such sewer shall be more than 75 m distant in the length of such sewer from the center of an inspection chamber or manhole.

## 2.11 Construction and sizes of Inspection Chambers

Every inspection chamber shall be of such internal dimensions as the authority shall require, save that the finished internal horizontal dimension of inspection chambers shall be governed by the number of inlets and that of any event the minimum internal dimensions of these chambers shall be:-

Depth of invert	Internal Dimensions	
	Length	Width
(i) up to 0.5	0.5m	0.5m
(ii) 0.5 m – 1.0m	0.6m	0.5m
(iii) 1.0 m – 1.5m	1.1m	0.6m
(iv) over 1.5m	1.1 m	0.8m

## 2.12. Inspection Chambers in Buildings

Inspection chambers located in buildings shall be built in walls not less than 225 mm thick rendered in cement and sand (1: 3) trowelled smooth and finished not less than 20 mm thick internally. The cover shall be of the double cover screw down type on rubber or other watertight and airtight seating and shall be made and maintained watertight and airtight.

## 2.13 Inspection Chamber Covers

Every inspection chamber of manhole shall be fitted with a strong, movable airtight cast iron manhole cover and frame of fine quality metal and of adequate size and approved design and construction, fixed not lower than the surface of the adjoining ground or floor and so that surface or rain water cannot course over it.

## 2.14 Channels and Benching in Inspection Chambers

Branch drains shall discharge into the main channel by means of splay channel bends. A drain pipe whether it branch or main, shall not project inside the walls of an inspection chamber by more than 50 mm.

Channels shall be of salt-glazed or glazed fireclay ware or other approved material of half-round or three-quarter cross section as may be required to prevent riding or splashing. In-situ channels shall have the same cross-section and shall be finished in cement mortar (1: 3) trowelled smooth. Sides

of channels in every inspection chamber shall be brought up vertically to a height not less than the diameter of the drain pipes and in any event sufficiently high to prevent riding or splashing from branch drains.

Benching shall be in concrete mix (1: 3: 6) and channels at an angle not less than 20° and not more than 30° from the horizontal and rendered with cement mortar (1: 3) not less than 15 mm thick, trowelled smooth.

### **2.15 Deep Inspection Chamber of Means of Access**

Deep chamber shall be provided with adequate vertical shafts, not less than 675 mm<sup>2</sup> and shall be provided with step-irons firmly built in the walls at vertical intervals of 300 mm and staggered at 190 mm center to center.

### **2.16 Ventilation**

A drain shall be properly ventilated with at least one ventilating pipe not less than 100 mm diameter in case of the main drain and in the case of a branch drain, not less than the diameter of the branch drain itself. The ventilating pipe shall be immediately connected to the branch drain pipe. The vent pipe shall be located as near as practicable to the building and shall be brought to such a height so as to effectually prevent any escape of foul air from the drain into the building in the vicinity thereof. The top end of the ventilating pipe shall not be less than 1 m above the eaves level of any adjoining roof and not less than 1.5 m above the top of any opening into a building within an unobstructed distance of 6m horizontally.

The end of ventilating pipes shall be adequately covered with an approved copper or aluminum mosquito wire gauze securely fixed on.

### **2.17 Soil Pipe Materials**

Soil or vent pipes shall be constructed of cast iron, Plastic or other equal and approved materials complying with the relevant BS or US.

- (i) wherever a soil or vent pipe is located it shall be permanently and easily accessible for inspection and maintenance.
- (ii) No soil or vent pipe shall pass through any habitable room unless enclosed in a duct constructed in such manner and of such material as shall be approved by the authority.
- (iii) If any soil or vent pipe is fixed in a chase or duct movable access covers shall be provided in such a chase or duct at all inspection points in the soil or vent pipe.
- (iv) Any soil or vent pipe inside a building shall be of cast iron or other approved material and shall have airtight socket joints.
- (v) Soil or vent pipes shall not be encased in the thickness of solid walls.
- (vi) Soil pipes shall be circular and of an internal diameter of not less than 100 mm and shall be continued up without diminution in diameter and without any bend or angle being formed in such soil pipe to such a height and in such a position as is required under these rules.
- (vii) Inspection eyes shall be provided at all bends and junctions in soil pipes. No right-angled junctions shall be made in soil pipes and branch soil pipes shall join others obliquely in the direction of flow. All bends and turnings shall be truly curved and shall not reduce the internal diameter of the pipes.



## 2.18 Anti-Siphonage to Soil Pipes

Soil pipes receiving discharge from more than one soil- water fitting shall have the following provisions:-

- (i) Traps of the soil-water fittings shall be ventilated by an anti-siphon pipe which shall have an internal diameter of not less than 50 mm and shall be connected to the arm of the soil-pipe at a point within 750 mm from the highest point of the trap on the side of the water seal nearest to the soil pipe.
- (ii) Anti-siphon pipes shall either have open ends as high as the top of the soil-pipe OR be carried into soil pipes at points above the highest connections to the same soil-pipes.
- (iii) Anti-siphon pipes shall be of cast iron, plastic or other equal and approved materials complying with the relevant BS for the main soil-pipe and shall be jointed appropriately.

## 2.19 Channels or Open Drains

- (I) Channels or open drains for the conveyance of foul water shall be semi-circular in cross-section and of salt-glazed vitreous enameled clay ware and masonry lined with cement and sand (1: 3), 15 mm thick trowelled smooth. All channels shall be in concrete (1: 3: 6) not less in width than 150 mm greater than the finished width of the channels and not less than 100 mm in thickness. Where such channel is greater in depth than the radius the side and top shall be of glazed tiles or rendered with cement mortar (1: 3) not less than 15 mm thick trowelled smooth.

- (II) Channels or Open Drains

The permitted length of channels shall be as follows:-

- (a) an external channel for the conveyance of waste-water only to an external gully trap, shall not exceed 2m.
- (b) A channel or open drain for the conveyance of foul water from premises used or to be used as from a slaughter house, stable, cowshed, or other places of like nature to an external gully trap, shall not exceed 2 m in length.
- (c) Internal channels shall be permitted only in premises described here below and can be of unlimited length :-
  - (i) premises mentioned in paragraph (6) above.
  - (ii) Laundries or rooms used for ablutionary purposes provided they are not within a dwelling.
  - (iii) Ice factories or aerated water factories.
  - (iv) Laboratories as long as such channels do not connect two or more rooms and do not receive the discharge from any waste water fitting other than from a sink used or used solely for laboratory purposes.
  - (v) Institutional kitchens or other premises approved by the authority for the reception and disposal of floor washings.

## 2.20. Waste-Pipes and Waste Water Fittings

- (a) Waste-pipes and overflow pipes shall be made of cast iron, wrought iron, copper, plastic or other material approved by the Authority. Waste pipes and over flow pipes more than 1.25 m long shall be fixed at angles not greater than 70° from the horizontal without antisiphonage measures being provided.
- (b) Waste pipes shall be properly trapped by of an efficient siphon trap, located as near as practicable to the point of which such waste-pipe or over-flow pipe is attached to the waste-water fitting.

Under special circumstances untrapped waste pipe may be and shall not exceed 2 m in length. Such untrapped waste pipe shall discharge externally into an open channel not less than 600 mm in length.

- (c) Waste-pipes shall have internal diameters of not less than 40 mm save in case of a lavatory basin waste-pipe which can be 35mm internal diameter. Waste-pipes which receive the discharge of more than one waste water fitting shall have internal diameters of not less than 50 mm. However waste-pipes receiving the discharge from not more than two lavatory basins may be of 40 mm internal diameter.
- (d) Waste-pipes shall be taken through external walls at the nearest practicable points and shall discharge over open channels or trapped gullies. Waste-pipes shall discharge at heights of not more than 75 mm above the invert level of channels or above the trapped gullies as to minimize splashing.
- (e) Waste-pipes not exceeding 3.65 m in length shall be vented from a point as near to the traps as possible and such venting shall be contrived as per the provisions for anti-siphon pipes.
- (f) No right-angled branch joints shall be made in waste-pipes. Every branch waste pipes shall joint another waste-pipe obliquely in the direction of the flow of such waste pipe and all bends and turnings shall be truly curved. Whenever required, adequate and satisfactory means of access shall be provided at junctions or bends in waste-pipes.

## 2.21 Rain Water Pipes

Rain water down pipes shall be solely for disposal of rainwater from the roof buildings and shall not be used for the purpose of carrying soil-waste, waste-water or be used as a ventilating pipe, anti-siphon pipe to any drain, soil pipe or waste-pipe.

## 2.22 Overflow Pipes

Overflow pipes from any water storage cisterns, flushing cisterns or water-waste preventers shall not be connected to drains, soil-pipes, waste drain pipe, ventilating pipes or soil-water fittings. Overflow pipes shall discharge into external open air and whenever possible in a conspicuous position. Overflow pipes shall **be protected** against the ingress of mosquitoes, insects and other vermin.

### 2.23 Requirement of Gully Traps

Gully traps shall whenever possible provided in suitable positions outside the building to receive effluent foul or waste water prior to connecting to the drain pipe. Gully traps shall be:-

- (a) Of good glazed stoneware, cast iron, pitch fibre or other approved material.
- (b) Provided with a water seal of not less than 65 mm in depth and an outlet of not less than 100 mm diameter.
- (c) Wall and securely fixed in a concrete (mix 1:3:6) surrounding not less than 100 mm thick shall be cast iron, mild steel and with the top finished protected against the ingress of surface or storm with a solid Kerb, smooth on the inside, at least 100 mm high above the adjoining ground level to prevent the ingress of surface or storm water.
- (d) Fitted with a cast iron, steel, concrete or other approved movable grating or cover.

### 2.24. Provision of Grease Traps

Whenever liquid waste of a fatty character is to be discharged into a drain or sewer, an approved grease trap shall be provided at a point preceding in-let of the drain or sewer. The grease trap shall be fitted with a cast iron, zinc, galvanized iron or other approved tray or of such an approved character perforated or of a sieve for the liquid to filter through prior to discharge into the drain or sewer.

### 2.25. Septic Tanks and Cesspool Biological Filters

Septic tanks, cesspools and other works for the treatment, reception or disposal of sewage shall :-

- (a) not be constructed under any buildings or nor within 3 m of any building or plot boundary; nor within 30.5 m of any well, spring or stream of water used or likely to be used , by man for drinking or domestic purposes or for manufacturing drinks. Nor be constructed in such a position so as to render any such water liable to pollution.
- (b) Be constructed in such a manner and in such a position as to afford means of access thereto for the purpose of cleaning the same and removing the contents thereof.
- (c) Be provided with sufficient cover and be so protected as to prevent any nuisance from emanating therefrom and prevent the breeding of mosquitoes in connection therewith.

### 3.0. SUBTERRANEAN STORM AND SURFACE WATER DRAINAGE

#### 3.1 Site

The drainage of sites and roofs of buildings shall comply with the following:-

- (a) The sub-soil of the site of the building shall, where the depress of the site renders it necessary, be effectively drained by means of earthenware field pipes or other suitable pipes properly laid to a suitable outfall, or other manner which the authority may require.
- (b) The roof of the building shall be so constructed as to drain effectively to suitable and sufficient gutters on trough, unless a splash apron in concrete or other approved impervious material sufficient to protect the foundations of buildings is provided.

Where gutters or troughs are used they shall be connected to a sufficient number of downpipes constructed so as to carry away all water from the roof without causing dampness to any part of the walls or foundations of buildings and shall cause such water to be carried off in a manner approved by the Authority.

- (c) Provision shall be made for carrying off any surface water of a building when desirable and in a manner approved by the Authority.
- (d) Rain water pipes or trunks for the purpose of conveying any water from a roof shall not be connected to discharge directly into a **closed drain** but shall be caused to discharge directly into the open air, into an open channel, pavement drain or over a properly trapped gully, or into such gully above the level of the water in the trap thereof.

#### 3.2 Roof

Eaves gutters and downpipes shall be of galvanized iron, steel, cast iron, or other equally suitable materials approved by the Authority and shall conform in all respects to the relevant BS or US Specification. In an as much as is practicable, a rain water harvesting system shall be installed on buildings to conserve the rain water and control floods. The design and particular specifications shall be provided in the contract documents, where rain water harvesting system has been provided for.

#### 3.3. Surface water

All eaves gutters shall be borne and supported by approved brackets not more than 1m apart, and shall be properly aligned so as to provide continuous and even fall to the point of discharge. Discharge or outlet points shall be spaced at not more than 9.15 m center to center.

#### 3.4. Drains, Sewers and channels for surface or storm water

Materials for the construction of drains, sewers and channels for the surface or storm water drainage shall conform to the specification in the Building Byelaws. Sewers and drains shall be laid to suitable falls, complying wherever practicable with the following requirements:

Diameter of pipe (mm)	100	125	150	175	225	300
Minimum Fall	1:50	1:60	1:75	1:120	1:150	1:200

### **3.5 Silt Traps and Grills or Gratings**

Before every inlet to a storm water sewer an approved silt trap shall be provided.

Metal or other approved grills or gratings shall be provided in every system of drains and channels for stormwater to retain all solid matter at a point as near as practicable to where such system connects with the public sewer. All stormwater shall pass through such grill or gratings which shall be easily accessible for cleaning and if necessary shall be built in conjunction with an inspection chamber.

# **PART 3**

# **ELECTRICAL SERVICES**

## 1.0 GENERAL REQUIREMENTS

- 1.1 General Electrical Requirements specified in this technical specification are in addition to the requirements of the General Conditions of the Contract and specific requirements set to the particular project in the Specification and Bill of Quantities.
- 1.2 The supply, erection, installation, testing and commissioning of the complete Low Voltage (400/230V) supply network electrical installation services and street lights as shown on drawings, schedules and described in the Specification and Bill of Quantities for each work shall be understood as included.
- 1.3 The procurements, installations and other works described in this specification and other related design documents are for manufacture, testing, supply, delivery to site, execution, demonstrating, commissioning and maintaining of the specified system to complete and fully operational condition.
- 1.4 Any work whether shown or not on the drawings and/or described in this specification but which can reasonably be inferred as necessary for the completion of installations and proper operation of the systems will also form part of the extent of the contract.
- 1.5 Workmanship and the method of installation shall conform to IEE Wiring Regulation Sixteenth Edition and Uganda Code for Electrical Installations and Equipment in Buildings. All work shall be performed by skilled tradesmen to the satisfaction of the Project Manager. Any work that does not conform to the best standard practice will be removed and reinstated at the contractor's expense.
- 1.6 Permits, Certificates or Licenses must be held by all tradesmen for the type of work in which they are involved and such Permits, Certificates or Licenses exist under Government Legislation.
- 1.7 The Contractor shall be responsible for the coordination of the works on site with other trades. The Contractor shall plan the installation before the work is commenced and he shall ensure correct installation to the design intent during the course of construction. Any work which has to be re-done due to negligence in this respect shall not constitute an extra to the contract.
- 1.8 The Contractor shall produce and submit shop drawings for the inspection of the Project Manager prior to any installations as required in the General conditions of the contract.
- 1.9 Copies of all shop drawings shall be submitted to the Project Manager for approval. Thereafter the contractor shall submit copies of approved working drawings.
- 1.10 The form (transparencies/paper copies) and number of sets of shop drawings to be submitted to the Project Manager shall be as specified in the General Conditions of the Contract.
- 1.11 The Contractor shall prepare and submit complete 'as-installed' drawings of all installations for the inspections of the Project Manager. All 'as-installed' drawings have to be approved by the Project Manager.
- 1.12 The form (transparencies/paper copies/diskettes) and number of sets of final approved 'as-installed' drawings to be submitted to the Client shall be as specified in the General conditions of the Contract.
- 1.13 After completion and the preliminary handing over of the systems, the Contractor shall supply to the Project Manager complete relevant operation, maintenance and data manuals and instructions of all systems and equipment in English.

- 1.14 The Contractor shall be responsible for the work, materials and equipment provided/executed under the contract. The Contractor shall guarantee that all materials and equipment of the systems are suitable and of sufficient capacity to meet the specified performance requirements set for them in the related design documents. The Guarantee and Maintenance period shall be as stated in the Particular or Special Conditions of Contract.
- 1.15 Electrical materials shall be stored in locked rooms or containers in their original packing. Light fixtures, sockets, switches, boards and the like shall be stacked on shelving, ensuring that no damage is likely to occur by stacking one over the other. Different materials shall be stacked at different locations.
- 1.16 The Contractor shall comply with all statutory requirements and regulations issued by any Uganda Authority within whose area of jurisdiction the project site is located.



## 2.0 ELECTRICAL WORK

The scope of the electrical work to be carried out by the Contractor shall be stated in the contract documents and shall generally comprise the following :

- 2.1 Complete installation of all cable routes including cable trays, raceways and ladders, trunking and all necessary conduits for surface and flush mounted installations and cabling of 400/ 230V networks.
- 2.2 Complete installation of Main Distribution Board (MDB), all Sub Main Distribution Boards (SMDBs), Final Distribution Boards (FDBs) and motor control centers (MCCs).
- 2.3 Complete installation of earthing and lightning protection systems.
- 2.4 Complete installation of all luminaires including normal luminaires as well as self-contained emergency luminaires.
- 2.5 Complete installation of diesel generating system where required.

### 3.0 RELATED BUILDER'S WORK

- 3.1 All builder's work including concrete foundations and support structures necessary and required for the electrical equipment and service shall be provided whether such works are shown in full details on the design drawings or not.
- 3.2 The Contractor shall provide reinforced concrete foundations for all floor mounted equipment and machinery in accordance with requirements and instructions of the equipment manufacturer.
- 3.3 The Contractor shall provide to the Project Manager fully dimensioned builder's work drawings showing all foundations, bases, and holes required and the overall sizes and masses of the plant concerned.
- 3.4 The Contractor shall provide necessary concrete foundations and supports for items requiring supports, such as hangers for conduits, cable trays, etc. Support structures shall be constructed of steel of adequate strength, bolted or welded together and painted with two coats of lead primer. Unless otherwise specified, welding of supports to the building structure steelworks is not permitted.
- 3.5 All methods of anchoring and fastening to building structure shall be detailed and submitted to the Project Manager for approval prior to any such installations.
- 3.6 Foundations shall be designed to fit the shape of the complete base and shall conform to the contour designated by the manufacturers. All necessary anchor bolts, washers, templates, etc. shall be furnished complete and bolts shall be built into foundations with properly sized sleeves.
- 3.7 Vibration isolation units shall be provided to minimize the intensity of vibration and noise to the building structure as specified.

## **4.0 CLIMATIC CONDITIONS/SPECIAL REQUIREMENTS FOR EQUIPMENT**

- 4.1 All materials and equipment shall be capable for continuous and prolonged operation in the prevailing climatic conditions of UGANDA. When selecting materials and equipment, the effect of sunshine, thunderstorms and the impurities within the air shall be taken into account.
- 4.2 Particular attention is to be paid to the effects of high or low altitude. Low density of air decreases insulating and heat transfer capacities of all electrical equipment. Consult manufacturers of all materials and equipment to obtain valid de-rating factors.

## 5.0 ELECTRICAL SUPPLY

5.1 All electrical equipment, accessories and fittings shall be designed and manufactured to operate continuously in the electricity supply system of Licensed Service Provider mains supply or emergency supply from the stand-by diesel generating set having the following characteristics:

- a) Voltage 400/230 volts
- b) Phase, **PME** (Protective Multiple Earth) system
- c) Frequency 50 Hz
- d) Neutral Solidly earthed

## 6.0 STANDARDS AND SPECIFICATIONS

- 6.1 The whole of the Electrical works shall be carried out in compliance with:
- a) Uganda Code for Electrical Installations and Equipment in Buildings.
  - b) The latest Regulation issued by the Electricity Regulatory Authority;
  - c) The relevant Regulation of BS 7671:1992 and Amendment No.1,1994 (AMD 8536) "Requirements for Electrical Installations" (IEE wiring Regulations 16th Edition);
  - d) IEC publication 60364 -Electrical Installations of Buildings Part 7-712: Particular requirements for special installations of Solar Photovoltaic (PV) power supply systems;
  - e) And the latest relevant recommendations of the International Electro-technical commission (IEC) and other approved national standards.
- 6.2 Except where otherwise indicated in the specification, the contract works and all manufactured items shall comply with the relevant BS or US as appropriate. In each case the latest edition of such specifications shall apply. Should it be necessary to order equipment covered by other National or International Standards, the approval of the Project Manager must be obtained, in writing, before completing the tender documents.
- 6.3 The Contractor shall submit for the Project Manager's evaluation standards, catalogues, manuals and drawings of all proposed materials and equipment to present the proposed equipment. The contractor shall also, prior to any procurement, obtain the Project Manager's approval for any departures and deviations from the final design drawings and specifications.
- 6.4 Where standards to which equipment and material must comply are cited, equipment and materials meeting other approved standards may be accepted. Where materials, appliances and fittings, patented or otherwise, are prescribed, or the names of manufacturers are given, the intent is only to establish the quality and required services. Substitutes of equal quality to that specified shall be accepted subject to prior approval by the Project Manager. Such proposal by the contractor shall be accompanied with sufficient evidence and comparison table to demonstrate that, the required critical parameters are of equivalent standard.
- 6.5 No order shall be placed by the Contractor for major equipment unless written approval of the Project Manager has been obtained.
- 6.6 All materials shall be new, meet the requirements set for them in this specification and in the General Conditions of the Contract and they shall be approved according to the contract regulations.
- 6.7 Unless otherwise indicated, the Contractor shall obtain similar types of electrical equipment from the same manufacturer wherever practicable. The components within any equipment shall as far as possible be produced and assembled by the same manufacturer.
- 6.8 The Project Manager has the right to reject material or equipment which does not comply with requirement of the specification. In such case the Contractor shall provide other materials or equipment that comply with the specification.
- 6.9 All electrical equipment shall be provided with suitable means of suppressing radio frequency interference fully in accordance with various requirements stipulated in relevant international standards. Especially for rotating equipment and for dimmer systems shall be provided further radio interference suppression confirming these equipment will in no way cause interference with the radio communication or any other telecommunication, extra low voltage or

control system.

## 7.0 POWER INTAKE-UNDERGROUND AND OVERHEAD

- 7.1 Underground cable ducts for incoming power supply cables and telephone service cables to 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 Uganda Electricity Distribution type. Ends shall be carefully trimmed of all Company and Telephone Distribution burrs. Joints shall be made using adhesive Company to ensure that their requirements supplied or recommended by the conduit are fully satisfied. It shall be the Contractor's manufacturer. responsibility to ensure that adequate information concerning easy bends, directions or runs, etc., is given before work commences.
- 7.2 Overhead suspended cables shall be mounted 9.1 Underground cables shall be PVC insulated, so that the lowest point is at least 2.7m above ground level. The cables shall be held in position by suitable brackets and strain relief to prevent mechanical wear and stress of electrical connections. Cables for outdoor exposed usage, shall be fully UV-resistant.
- 7.3 Pre-cast concrete and PVC pipes shall comply with BS 3505 BS 5481 respectively.
- 7.4 Manholes shall be in pre-cast concrete C-20 quality, brick or Class A hollow block-work as indicated and detailed on the drawings. The manholes shall be laid on a minimum concrete bed of 150mm, C-20 concrete. Manholes other than pre-cast concrete shall be rendered internally and externally with two coats of cement mortar. Joints of pre-cast concrete manholes shall be flush pointed. Manholes covers shall be in cast iron cover and frames or C-25 pre-cast concrete as detailed on drawings.

## 8.0 CONDUITS FOR INTERNAL WIRE DRAWING

- 8.1 All metal conduits shall be medium gauge and shall be laid in straight and symmetricallines. The end 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.
- 8.2 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 will be permitted, unless specifically mentioned in the specification or on the drawings.
- 8.3 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 or recommended by the conduit manufacturer.



## 9.0 CABLES (SINGLE AND MULTI-CORE) AND CONDUCTORS

- 9.1 Underground cables shall be PVC insulated, PVC bedded, steel wire unarmoured-armoured and PVC served overall. Unless, specifically indicated otherwise, all cables shall have multi-strand copper conductors.
- 9.2 Cables shall be in accordance with Uganda Code for Electrical Installations and Equipment in Buildings and shall be of approved manufacture in accordance with BS 6004, 6007 & 6346 or other appropriate BS, IEC or manufacturer's standard and specification and the current carrying capacity of the conductors shall be according to Uganda Code for Electrical Installations and Equipment in Buildings and the relevant tables in the IEE Wiring Regulations 16th edition.
- 9.3 All internal wiring shall be in PVC insulated cables and /or conductors and colour identification shall be in accordance with the relevant Clause of Uganda Code for Electrical Installations and Equipment in Buildings.
- 9.4 Underground cables shall be at least 0.6m below the surface and be indicated with markers (coloured plastic tape, minimum 50mm wide or lining with bricks or slates, 0.2m above the cable).
- 9.5 Before cables are laid, the bottom of the trench shall be evenly graded and cleared of loose stones and shall then be covered with 50mm layer of sand or sieved earth which shall have been pressed through sieve with a maximum mesh of 13mm.
- 9.6 The cables shall be carefully laid in the bed without dragging and they shall then be covered with fine sand or sieved earth in such quantity as to ensure a cover of 75mm after tamping.
- 9.7 The warning tape shall be coloured yellow/black stripes and bear the following legend in block black capitals, at regular intervals: "Caution-Electric Cable Below" It shall be laid at a depth 200mm below final grade.
- 9.8 Concrete marker posts shall be erected at intervals of 25m and at changes of directions of cable trenches and throughout the length of cable route. A plate shall be fixed to the post stating "Buried Cables" and their position marked on the final "As Installed" drawings.
- 9.9 Adequate number of ducts shall be provided at points of entry into buildings. These shall be in form of easy sweep ends, having a bending radius appropriate to the size of the largest cable but in any case not less than 10 times a cable diameter.
- 9.10 After installation and the final tests, all cable ducts will be sealed using fine resistant materials to the satisfaction of the Project Manager, to prevent ingress into buildings of water, vermin termites etc.

## 9.0 MAIN AND SUB DISTRIBUTION BOARDS

- 10.1 The Contractor shall supply and install distribution boards in the positions indicated on the drawings. All main, sub-main distribution boards shall be complete with isolator or fused switch as applicable and shall conform to BS EN 60439. Distribution boards shall be in accordance with Uganda Code for Electrical Installations and Equipment in Buildings. The Contractor shall submit detailed drawings of the proposed panel layout for approval of the Project Manager.
- 10.2 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.
- 10.3 Distribution boards shall be of the type fully enclosed sheet steel or PVC cabinets with hinged cover and protection class shall not be less than IP 43. Each compartment shall be a one standard panel section having the number of pitch units as detailed in the drawings. Boards shall consist of approved single double and triple pole moulded -case and/or miniature circuit breakers. The current rating and type of each panel shall be indicated on the appropriate distribution boards diagram.
- 10.4 Consumer units shall comply with BS EN 60439 and shall be provided with an internal circuit designation chart. These shall be securely fixed ,and equipped with Perspex or similar covers and shall have space for each outgoing circuit to give clear identification. Unprotected paper labels will not be accepted.
- 10.5 Main switchboards and control panels shall be equipped with voltmeter, ammeter selection switches and indicating lamps. All instruments and protective relays shall be flush mounted and effectively sealed against ingress of moisture, dust and insects.
- 10.6 Moulded-case circuit breakers shall comply with BS EN 60947-2.They shall have the voltage and current ratings, rated duty, rated short-circuit breaking capacity and rated short-time withstand current as indicated.
- 10.7 Miniature circuit-breakers shall comply with BS EN 60898 and shall have the voltage and current ratings and category of duty and be of the type as indicated.
- 10.8 Contactors shall comply with BS EN 60947-4-1 and be electromagnetic suitable for the control arrangement as indicated.
- 10.9 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.
- 10.10 Un-used reserve pitch units shall be fitted with moulded plastic cover strips. Full facilities shall be provided within the panels 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 form each distribution way and the size of the fuse or circuit breaker rating. The information must either be typed or printed on the card, or presented in similar legible manners.
- 10.11 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.

## 10.0 WIRING ACCESSORIES, SMALL EQUIPMENT AND MATERIAL

- 11.1 Accessory boxes shall comply with BS 4662 or BS 5733 and where they are of insulating material they shall have the ignitability characteristic 'P' as specified in BS 476.
- 11.2 Accessory boxes shall be of adequate depth to accommodate the accessories without causing compression of the cable. Generally boxes shall be 35mm deep and shall have one fixing lug that is floating so that the final level of the accessory can be adjusted.
- 11.3 Front plates of accessories shall be of the material and finish as indicated, but generally the finish of various types of accessories in the same area shall match. For flush mounting the plates shall overlap the boxes. For surface mounting the plates shall match the profile of the box without overlap.
- 11.4 Where pilot lamps are required they shall comprise a neon lamp with resistor and a red coloured lens, unless otherwise indicated.
- 11.5 Wall mounted switches located inside buildings shall have rocker type actuating members unless otherwise indicated. Where mounted adjacent to one another they shall be grouped in a multi-gang box with a common front plate.
- 11.6 Dimmer switches for the control of tungsten filament lamps shall comply with BS 5518. For other dimmer switches the limits and the method of measurement of radio-frequency interference generated by the electronic assembly shall be in accordance with BS 800.
- 11.7 Socket outlets shall be switched type as required, and of the type and rating where indicated and may have pilot lamps where required.
- 11.8 Socket outlets for wet locations shall be provided with spring loaded cover required to achieve total enclosure to ensure the required degree of protection against moisture.
- 11.9 Unless otherwise indicated, time switches shall be self-starting, self-winding, synchronous motor type rated at 230 volts. The motor shall be protected by a fuse, which shall be easily accessible. The rated current of the switch shall be as indicated.
- 11.10 The sensing unit of photo-electric control shall comprise a photo-conductive cell enclosed in a translucent plastic dome sealed to a mounting base. The control unit shall comprise a load controlling single pole switch; its rated current shall be as indicated.
- 11.11 Bells and buzzers shall have contact-less movements and shall not incorporate a transformer. Bell gongs shall have a minimum diameter of 75mm unless otherwise indicated. For bells mounted outside a building, the enclosure shall provide a minimum degree of protection of IP54 and shall have a tapped entry for steel conduit. The base and cover of buzzers shall be of plastic material.
- 11.12 Push-button shall have a current rating 1A unless otherwise indicated and shall be suitable for flush or surface mounting as indicated.
- 11.13 Indicator units for alarm or call system shall incorporate the number of signals as indicated and enclosures shall be of metal, wood or plastic and finished as indicated. Glass front plates shall be finished black and inscriptions shall be as

indicated.

- 11.14 Plugs rated at 13A shall be of a non-resilient material unless otherwise indicated and fused plugs shall be fitted with fuses rated as indicated.
- 11.15 Air conditioners shall be of the specified size, rating and finish as specified in the Bill of Quantities and shown on drawings and shall be understood as including all related work.
- 11.16 Fans and extractors shall be wall mounted or hanging of the specified type and rating shown on drawings or schedule and specified in the Bill of Quantities.
- 11.17 Conduits for telephone system shall be installed complete as indicated on drawings. The wiring for each telephone outlet shall be carried out by the Authority having jurisdiction .The Contactor shall liaise with the Authority having jurisdiction to verify that adequate concealed conduits have been included.
- 11.18 Conduits for television system shall be installed complete as indicated on drawings. The wiring for each television outlet shall be carried out by the supplier and /or manufacturer .The Contactor shall liaise with the supplier and /or manufacturer to verify that adequate concealed conduits have been included.
- 11.19 Conduits for computer network system shall be installed complete as indicated on drawings. The wiring for each data outlet shall be carried out by the supplier and /or manufacturer. The Contactor shall liaise with the supplier and /or manufacturer to verify that adequate concealed conduits have been included.
- 11.20 Terminal blocks shall comprise connectors contained within a moulded housing. The moulded housing shall be of an insulating material suitable for the maximum operating temperature of the conductors.
- 11.21 Conductors shall be clamped between metal surfaces and no screws shall make direct contact with conductors. The design shall be such as to maintain sufficient contact pressure to ensure connections of negligible impedance at all time.
- 11.22 Mounting heights of accessories or equipment shall be in accordance with Uganda Code for Electrical Installations and Equipment in Buildings unless otherwise indicated. Where difficulty in locating of accessories or equipment occurs the Project Manager shall be consulted.

## 11.0 INFORMATION AND COMMUNICATION TECHNOLOGY

- 12.1 Asynchronous Transfer Mode (ATM) which supports speed up-to 155Mbps integrating voice, data, image and multimedia shall be used where increased band width application is required.
- 12.2. The fast Ethernet standard (100Mbps) over Unshielded Twisted Pair (UTP) cable shall be used for connection of desktops from hubs.
- 12.3. Unshielded Twisted Pair (UTP) floor cabling which supports multiple applications – Voice, Data and multimedia is recommended for local area net working.
- 12.4 For riser backbone system connecting different levels of floors with the server optical fiber cables shall be utilized.
- 12.5 Server is a powerful computer that provides services to other computers and devices on the network and is usually located on ground floor or basement.
- 12.6 Modular patch panels shall be used for the termination and interconnecting of data circuit in structured cabling system.
- 12.7 Data outlet points are those points in the network where all the computers and other devices are interconnected. The data outlet points shall be RJ-45 fed through Cat 6 Unshielded Twisted Pair (UTP) cable.
- 12.8 The wiring for each data outlet shall be carried out by the supplier and /or manufacturer. The Contractor shall liaise with the Supplier and /or manufacturer to verify that adequate trunking system and concealed conduits have been included.
- 12.9 Conduit installation for telephones, public address, radio and televisions shall be carried out to the same standard as for power and lighting services. Where detailed in the Particular Specifications, plastic conduits shall be used and, when necessary, an earth wire drawn in cables or draw wire shall be installed as specified.
- 12.10 Broadband and Power over Ethernet applications shall comply with IEEE 802.3, IEEE 802.5 and IEEE 802.af standards as a minimum.

## 12.0 LUMINAIRES AND LAMPS

- 13.1 Luminaires shall comply with BS 4533 and emergency lighting luminaires shall comply with Industry Standard and shall be marked with certification label and shall be installed as indicated on the drawing and the Bill of Quantities.
- 13.2 Tungsten filament lamps shall be of the general service type in accordance with IRR BS 161 and fluorescent lamps shall comply with BS 1853.
- 13.3 The Contractor shall include for the provision of handling, taking delivery, safe storage, wiring, assembling and erecting of all lighting fittings as specified. All means necessary to protect electrical materials and fixtures during transport and before, during and after installation shall be provided to ensure that no damage occurs to the materials or their surfaces. Electrical fixtures shall be supplied in their original packing.
- 13.4 All pendants fittings shall be fixed to conduit boxes with brass screws. Lighting fittings detailed for the purpose of establishing a high standard of finish shall under no circumstances be substituted without prior approval of the Project Manager.
- 13.5 In case of rectangular shaped ceiling fitting the extreme ends of the fittings shall be secured to suitable support in addition to the central conduit box fittings. Supports shall be provided and fixed by the contractor.
- 13.6 The whole of the metal work of each lighting fittings shall be effectively bonded to earth. Where ball and/or ankle joints are not made by the manufacturers, the contractor shall include cost of additional work necessary in his tender. Minimum size of internal wiring shall be 1.5 mm squared. Each lighting fitting shall be provided with the number, type and size of lamps as detailed in the specifications.
- 13.7 Self-contained emergency lighting luminaires shall be of the non-maintained type self contained and equipped with an 8W fluorescent tube and shall be fitted with a means of testing which shall comprise a push-button or similar device that cannot be left in the test position. They shall be provided with a means of isolating the lamp circuit for maintenance purposes.
- 13.8 Unless otherwise indicated, fixed luminaires shall be Class I and hand lamps shall be Class III rated at 50 volts.
- 13.9 Unless otherwise indicated, enclosure to luminaires shall provide a minimum degree of protection of IP20 when located within buildings and IP23 when located outside buildings, but luminaires mounted externally and less than 2m above finished ground of paved level shall be IP44.
- 13.10 The Contractor must order the appropriate type of lamp holder in ordering lighting fittings, to ensure that the correct lamp holders are provided irrespective of the type normally supplied by the manufacturer.
- 13.11 Lampshades shall be of the extra heavy duty and shall be provided for every specified lighting fitting. They shall be heavy brass type (except for plain pendants where reinforced bakelite type shall be used). Lampshades are supported by flexible cable, the holders shall have "Cord grip" arrangements and in the case of metal shades earthing screws shall be provided on each of the holders.

## 13.0 SITE LIGHTING

- 14.1 Site lighting columns shall be constructed and installed in accordance with BS 5649 and shall be of the type as indicated, columns set in ground shall be fitted with a base plate unless otherwise indicated.
- 14.2 The principal roads and access areas on the site shall be illuminated by suitable discharge lamps mounted on lighting columns or wall brackets on building.
- 14.3 The control of the lights shall be by means of an electromechanical timer switch having adjustable contacts and capable of operating for a minimum of 48 hours after interruption of the main power supply. The lighting control relay shall be located on the main switchboard and shall switch all lamps simultaneously via contactors.

## 14.0 LIGHTNING PROTECTION AND EARTHING

- 15.1 The lightning protection installation shall be in accordance with the recommendations of the British Code of Practice as set out in BS 6651-1985.
- 15.2 To ensure an effective system, particular attention shall be paid to the quality of the materials used which shall be electrically and mechanically sound and provide good erosion resistance in a tropical environment.
- 15.3 The whole structure shall be provided with air terminations, down conductors and earth terminations together with all necessary joints, bonds and earth electrodes including test joints.
- 15.4 The installation of the earthing system shall be in accordance with the:
- a) Recommendations of the British Code of Practice BS 1013;
  - b) Uganda Code for Electrical Installations and Equipment in Buildings and;
  - c) The latest Regulation issued by Uganda Electricity Regulatory Authority;
- 15.5 The Contractor shall supply, install and connect all necessary conductors, clumps, connectors, terminals, etc. for an efficient earthing system.
- 15.6 Each termination shall be constructed using copper rods buried into the ground to a depth of at least 3m. In order to achieve the necessary earth impedance, rods shall be combined in groups with a separation between rods not less than the length of the rods.
- 15.7 Concrete inspection pits shall be installed above each rod complete with copper bars to which bolted sections can be made to link earth rods together to form integrated network. To this bar shall also be connected all other earth connections, including the down conductors to form the lightning protection system.
- 15.8 The conductors between earth electrodes or groups of electrodes shall either be copper strip, copper braid or copper cable (un-insulated) and will be buried at a depth of 0.5m
- 15.9 Wall mounted copper earth bar shall be provided in each building for which an earth electrode shall be installed. This bar will act as a terminal strip for bolted connections from switchgear, earth, the casing of electrical equipment and any other structure which requires bonding to earth. All such connections shall be sized in accordance with IEE Wiring Regulations Sixteenth Edition.
- 15.10 Each termination networks not incorporating lightning shall have a resistance to earth determined by maximum earth fault loop impedance (as defined by the IEE Wiring Regulations Sixteenth Edition) which shall be acceptable for the correct functioning of the over current protection devices installed thereby.
- 15.11 The Lightning Protection System shall comply with BS 6651.
- 15.12 **Aluminium Tape**

Aluminium tape used for roof termination networks and down conductors shall be bare to BS 2898-1350 and shall have a minimum cross sectional area of 50mm<sup>2</sup>.



### 15.13 Copper Tape

Copper tape used for earthing shall be bare and made from high conductivity copper to BS 1432-C101/C103 and shall have a minimum cross sectional area of 50mm<sup>2</sup>.

### 15.14 Fixing of Tape Conductors

Conductor tapes shall be fixed to the background using metallic tape clips of the spacer bar type using 1! x no.10 countersunk wood screws and wall plug.

When straight through, cross or tee joints are formed in the tape, square tape clamps shall be used and these shall be fixed to the background as described above for tape conductor clips.

Copper conductor fixing accessories shall be made from high quality copper alloys and aluminium accessories shall be made from high quality aluminium alloys.

No accessory meant for copper conductors shall be used on aluminium conductor and vice-versa.

When aluminium fittings are installed – an approved oxide inhibiting compound shall be applied to the connection after it has been made.

At the junction between aluminium down conductors and copper earthing conductors, a bimetallic connector shall be used. The connector shall be firmly fixed to the background using 1! X no.10 countersunk wood screw and wall plug.

### 15.15 Air Termination Network

The air termination network shall be arranged so that no part of the roof is more than 5 metres from an air termination conductor.

### 15.16 Down Conductors

There shall be one down conductor for every 10 meters of the building perimeter at ground level.

Down conductors shall be as evenly spaced, and shall be routed as directly from the air termination network to the earth termination, as the building contour will permit.

The existence of re-entrant loops in the down conductors shall not be permitted, except as allowed by BS 6651.

### 15.17 Earth Termination Network

The earth termination network shall be executed in copper tape and copper clad earth electrodes only.

The connection between tape and earth rod shall be made with a proprietary rod to tape clamp of high strength copper alloy body and screw. Commercial brass shall not be used for this purpose. This connection shall be made at least 150mm above the immediate surrounding ground and enclosed in an earth inspection chamber.

The inspection pit and cover shall be made of concrete of internal dimensions 160 x 160mm and minimum depth of 210mm. The top of the pit shall not be

below the general surrounding ground.

#### 15.18 Earth Resistance

The resistance to earth of the complete lightning protection system measured at any point, shall not exceed 10 ohms.

The resistance of each individual earth shall not exceed ten times the number of down conductors in the complete system.

#### 15.19 Testing and Commissioning

As the installation proceeds and on completion of the installation and at the expiration of the maintenance period, the Contractor shall carry out tests in the presence of the Project Manager on all sections of the Electrical Services Installation and shall submit six signed copies of the results of the tests to the Project Manager, together with six copies of a Completion and Inspection Certificate as required by the IEE Wiring Regulations, Part 7.

Site testing of all systems and components comprising the Contract works shall be carried out in the presence of and to the complete satisfaction of the Project Manager, After the Contractor has first satisfied himself that the systems are operating correctly.

The Contractor shall prepare and submit for approval comprehensive commissioning documents prior to commencement of testing.

No section of the installation shall be energized until these tests have been completed.

The Contractor shall provide all certified instruments, equipment, plant, labour and materials necessary for conducting specified site tests and shall be responsible for and prepared to demonstrate the accuracy of all test instruments supplied by him.

All installations, plant and tests must satisfy the requirements of the Factories Act and the requirements of all other interested Authorities and the Contractor shall include for all safety devices, etc. required by such Act or Authority.

Observations shall be made of the operation and performance of the installations and subsequent readjustments made as necessary.

Accurate records of all commissioning and testing shall be kept and results comprehensively reported to the Project Manager when the installed system(s) are functioning correctly.

Where it is not possible at the particular time of commissioning and/or demonstration of the plant for full load conditions to be obtained or assimilated, the Contractor shall repeat the requisite operations of the commissioning and demonstrations under such full load conditions (or the reasonable approximation or simulation of such conditions acceptable to the Project Manager) at the first opportunity.

The Contractor shall ensure that all equipment and plant under his supply shall be tested at the maker's works before dispatch and six copies of test certificates in respect of each test shall be forwarded to the Project Manager.

All works tests shall comply with the relevant British Standard Specification or IEC Standard Specification and shall be sufficient to show that equipment will function correctly when installed as part of the Sub-Contract works.

Each item of electrical plant or equipment so tested shall be fitted with a plate giving at least the following information:

Date of Test

Individual equipment serial number

BSS number if any

Test Voltage

Operating voltage (if different from test voltage)

Test current

Full load current (if different from test current)

Loading (expressed in kVA) and power factor Phase

Frequency (expressed in Hz)

The above information shall be included on the test certificate for each item of plant or equipment. This shall also include a description of any particular method of wiring and/or connection with the location of the test and signature of the witness.

The following test results shall be submitted:

- a) Continuity of ring final circuit conductors
- b) Continuity of protective conductors, including main and supplementary equipotential bonding
- c) Earth electrode resistance
- d) Insulation resistance
- e) Insulation of site-built assemblies
- f) Protection by electrical separation
- g) Protection by barriers or enclosures during erection
- h) Polarity
- i) Earth fault loop impedance
- j) Operation of residual current devices and fault voltage operated protective devices
- k) Each circuit breaker shall be operated manually or electrically 50 times to the satisfaction of the Project Manager. Where the circuit breaker is designed for electrical operation at least 10 of these operations shall be made with 80% normal voltage applied to the trip coil in accordance with BS 116:1952. During this test the trip free feature shall be demonstrated.

#### 15.20 Scope of Works

The Contactor shall supply, deliver, install, set to work, test, commission and hand over to the Employer the complete Electrical Services installation inclusive of the following:

- (i) Power and lighting installation in all areas including supply to services

- to be installed by others, such as lifts, parking entrance shutters, parking control barriers, cooking equipment etc;
- (ii) Installation of lightning protection system;
  - (iii) Liaison with the Power Supply Authority for power connection to the building;
  - (iv) Liaison with the Telecommunication Authority for installation of incoming telephone cables into the building;
  - (v) Testing, certificate and commissioning of the services; and
  - (vi) Preparation of co-ordinated working drawings, record drawings and operating and maintenance manuals.

The foregoing is an outline description only and reference to the other Specification Clauses and site inspection must be made to assess the full extent of the works.

Should any portion of the work which would reasonably and obviously be inferred as necessary for the complete, safe, efficient and satisfactory operation of the installation as a whole, not be expressly described or specified – then such works shall be executed as part of the Contract at no additional cost.

In addition to the above – the Contractor shall quote a further extra over cost for the maintenance of the above systems for the first nine months of operation.

## 15.0 CLOSED CIRCUIT TELEVISION (CCTV) SURVEILLANCE

- 16.1 The works shall involve Supply and installation of a Closed Circuit Television (CCTV) Surveillance System complete with mounting accessories.
- 16.2 The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.
- 16.3 The CCTV system cameras shall produce sharp, detailed and stable images on the monitor in sufficient detail to provide positive identification of individuals within the protected areas under all conditions of light.
- 16.4 Where required, wide coverage public areas shall be viewed with pan, tilt and zoom (PTZ) IP cameras, to provide close up images and tracking of events. Fixed position and fixed focus IP cameras shall be used where a specific risk has been identified in a particular area and it is important that should an event occur it is viewed in real time or recorded.
- 16.5 The cameras shall be fitted with automatic light compensation devices to provide compensation for variations over a wide range of scene brightness. Where a camera must operate in total darkness, the nature of the possible events will be analysed to determine whether the situation requires a special application camera such as one that uses infra-red illumination.
- 16.6 The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.

## 16.0 CENTRALISED TELEVISION SYSTEM

- 17.1 The television system shall generally be centrally connected and distributed per Block. The television system shall comprise a DSTV Dish, UHF/VHF Antenna, Amplification and Distribution accessories and a fully integrated wiring system. The Contractor shall provide both accessible wire ways to facilitate the installation in accordance with the design and faceplates to outlets.
- 17.2 Wiring from distribution points to television outlets will be carried by the Contractor in 25 mm diameter conduits. Co-axial cables suitable for the television installation shall be used. Television outlet points shall be flush mounted with a steel box.

## 17.0 FIRE DETECTION AND ALARM SYSTEM

- 18.1 The works shall include supply and installation of the fire detection and alarm system elements complete with fixing accessories of the Menvier / GENT intelligent addressable fire detection system or approved equivalent.
- 18.2 The system components shall be Loop wired using using 2-core fire resistant OHLS 300/500V stranded copper cables.
- 18.3 The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.

## **19.0 TRAINING OF CLIENT'S PERSONNEL**

- 19.1 The Contractor shall upon the request of the Client, as a separate item, carry out training of a number of persons who will be selected by the Project Manager for the correct and careful operation, control and maintenance of all the electrical services provided under the Contract before the final taking over of the project.
- 19.2 The training shall be carried out by the qualified commissioning staff of the Contractor for each particular service and shall be continued throughout the contract period till the final taking over of the project, if the General Conditions of the contract do not call for more extended period or as mutually agreed between the client and the Contractor.



## 20.0 INSPECTION, TESTING AND COMMISSIONING

- 20.1 On completion of the electrical installation, the contractor shall, in the presence of the Project Manager or his representative, test the installations as required by the Project Manager and the local concerned authorities to demonstrate compliance with the IEE Wiring Regulations Sixteenth Edition and Uganda Code for Electrical Installations and Equipment in Buildings.
- 20.2 The following tests shall be carried out:
- a) Verification of polarity (D.C. and single phase/ earth circuit)
  - b) Phase rotation
  - c) Resistance to earth of earthing system
  - d) Insulation resistance. Phase / phase and phase / earth.
  - e) Earth loop impedance
  - f) Operation of over current and earth relays by injection tests
  - g) Levels of illumination
  - h) Correct sequencing of all control equipment
- 20.3 The works will not be accepted and taken over before the connection of power supply. After the power supply connection the contractor shall commission all his equipment to fulfill his contract obligations. Supply of power is the client's obligation.
- 20.4 The Project Manager shall be given full opportunity to witness all tests and shall approve all tests. He will have the right to ask for specific tests results to be repeated. The Contractor shall provide accurate instruments and apparatus and all labour required to carry out the above tests. The instruments and apparatus shall be made available to the Project Manager to enable him carry out such tests as he may require.

# **PART 4**

## **AIRCONDITIONING AND MECHANICAL VENTILATION**

**1.1 General**

The particular and general specifications for Mechanical Ventilation are detailed in this part. The Contractor shall supply and install Mechanical Ventilation equipment as detailed herein and in the Contract Drawings.

**1.2 Climatic Conditions**

The following climatic conditions apply at the site of the Contract Works and all plant, equipment, apparatus, materials and installations shall be suitable for these conditions.

Max. Highest Temp.	35 degrees Celsius
Min. Lowest Temp.	13.3 degrees Celsius
Mean Temp.	28 degrees Celsius
Relative Humidity	50% - 92%
Altitude	1312 meter A.S.L.
Longitude	32 degrees 36' E
Latitude	00 degrees 20' N

**1.3 Design conditions for air conditioning installation**

- a) Inside temperature for all areas shall be 22 degrees Celsius. All Noise Level Max 45dB
- b) Outside conditions: Temperature = 35 degrees Celsius, dry bulb;

**2.0 AIR CONDITIONING SYSTEM**

The air conditioning system shall be by split unit air conditioning system for the Conference rooms/Halls. The proposed split units shall be either Carrier/ Daikin/LG. The Contractor should adhere strictly to these contract specifications. No alternative brand shall be accepted

**2.1 Indoor Units**

This indoor units shall either be Concealed ceiling units or High wall split units. The indoor units shall be of low noise of 32dBA and shall operate on 240V, 50HZ, 1Phase. The indoor concealed ceiling units shall be with drain lift pump. The power supply shall have a built-in protection unit to prevent damage due to power fluctuations. The unit shall be fitted with a removable washable filter.

**3.0 DUCTING****3.1 Material**

The material from which the ductwork shall be made, shall be galvanized steel.

For ducts with the longer side equal to or less than 599mm, the thickness shall be 0.6mm.

For ducts with the longer side equal to or less than 1000mm, the thickness shall be 0.8mm.

For ducts with the longer side equal to or less than 2500mm, the thickness shall be 1.0mm.

**3.2 Construction and Erection**

All seams, joints and connections to plant shall be made so as to reduce air leakage to a minimum.

Internal roughness and obstructions to airflow (other than dampers, vanes etc) will not be accepted.

Sharp edges on corners or on the inside and outside of the ductwork, flanges, supports etc. will not be accepted.

All openings for branches shall be cut before the ducting is erected and shall not be less than the connection dimensions.

Connections to plant shall be made with angle flanged joints. Ductwork which may also have to be moved to enable plant to be removed or accessed for maintenance shall incorporate flanged joints, suitably painted and protected.

### **3.3 Fabrication and Consideration**

The Contractor shall supply and install ductwork runs and sizes as shown on the Tender Drawings. Alterations will be permissible only after Engineer's approval.

The Contractor shall be responsible for taking all measurements on site that are necessary for the manufacture of and installing of the ductwork. The Contractor shall make the arrangements, where necessary, for walls, doors, etc. to be down so that he can install the Plants.

The Contractor shall be responsible for checking all Architects, Civil Engineers, Structural Engineers and other Contractor drawings to see that the ductwork shall be accommodated within the structure and does not foul pipework, light fittings, electric trunking and all other services.

When ductwork is run in false ceilings, bulkheads etc. the Contractor shall ensure that adequate clearance is available for ceiling supports, light fittings and other services and equipment.

### **3.4 Sheet metal ducts**

All sheet metal ducts, unless otherwise stated for special purposes, shall be manufactured from galvanized mild steel sheets. All ductwork shall be constructed and installed in accordance with the Heating and Ventilating Contractors Association, specification for Sheet Metal Ductwork, DW 142.

### **3.5 Jointing of ductwork**

Jointing shall be arranged with the following:-

- a) Longitudinal joints up to and including 1.2mm duct thickness with Pittsburgh lock, riveted at a maximum of 65mm centres.
- b) Joints between ducts riveted, flanged or bolted according to sheet metal gauge, and location.
- c) Slip joints with a minimum of 75mm slip and be taped with Arbol No. 1291 or equal and approved.
- d) Loose flanges fitted where the position of the ducts cannot be determined during planning.
- e) Jointing compound for sealing joints of the slip type. Sealing strips according to application between flanges.
- f) Flanged drilled for 10mm diameter bolts at a maximum of 100mm centres, for duct sizes up to 760mm longest side, over 760mm longest side drilled for 10mm diameter bolts at 150mm centres except for holes in flanged connections to plant which shall be made with the plant flanges. All bolts, nuts, washers etc. shall be cadmium plated.

**NOTE:** The use of Imes 'Pop' rivets and huckbolts will normally not be allowed. The ductwork Contractors shall make specific reference in his tender to any constructional details on which his price

is based which are not generally accepted practice, and written approval of such items must be obtained prior to manufacture.

### **3.6 Flexible connections**

Flexible connections shall be as follows:-

- a) Revertex, silantium or neoprene or as specification Part C.
- b) Approximately 1500mm long fixed ends, minimum.
- c) Secured by either flanged or a bolted metal strip.
- d) Fitted between fans and ductwork.
- e) Fitted between grilles/diffuser and ductwork in ceiling grids.

### **3.7 Supports**

- a) Fixing from a structurally sound part of the building by mild steel straps, hanging brackets on rolled steel angle.
- b) Spacing at not more than 3m centres and beneath vertical risers. Branches must not be used as supports.
- c) For timber or heavy duty cork spacer between duct and the support where thermal insulation is specified; elsewhere felt inserts shall be provided.
- d) Fixing by clipping or building in. No drilling or burning holes and welding to the roof trusses and other building structural steel members will be permitted without written permission from the Engineer.
- e) The corners of rolled steel sections to be neatly trimmed off. Screwed rods used for duct hangers shall not project below the bolts.
- f) Equipment such as fans where fitted in ductwork shall be fitted with their own supports. The contractor shall ensure wherever fans or similar equipment are connected to the ductwork system, the connections are made with a heavy duty rot or vermin proof neoprene or similar material, flexible connection to prevent vibration transmission to the duct work or building fabric. Flexible connection shall be secured by a pre-drilled mating flange, or when fixing to a spigot, the spigot should be beaded and a jubilee clip or split flat iron ring should be used.
- g) Where ductwork passes through the structure which is not a fire barrier fireproof packing shall be provided between the duct and masonry with a mastic sealant.
- h) Where ductwork passes through floors and walls, galvanised sheet steel sleeves or builders' work timber frames shall be provided. The space between duct and sleeve or frame shall be packed with asbestos rope or mastic to prevent air movement or noise transmission from one space to another. Ducts must not come into direct contact with the building fabric.
- i) All supports and brackets shall be wire brushed and painted one coat of red oxide paint prior to and after erection. All nuts and bolts shall be sheradized. The fastening of electrical cables to ductwork will not be permitted.

### **3.8 Ductwork**

The Contractor shall supervise the positioning of ducting deliveries and off-loading of the plant. Duct runs shall be erected on the supports provided and aligned, prior to connections to items of equipment, to present a neat and workmanlike appearance with allowance made for all clearance for insulation and other adjacent services. Transverse joints for rectangular and circular ducts shall be made on site in a manner similar to that already detailed.

Transformation and taper pieces shall, wherever possible, be constructed so that the included angle does not exceed 30 degrees.

Air conditioning ducts shall be insulated with rock wool covered with aluminium foil.

### **3.9 Test Holes and Access Doors**

An adequate number of test holes shall be provided adjacent to all plant, inlet and outlet louvres, at branches, after balancing dampers and elsewhere as required by the Contractor for balancing the system. Test holes after dampers shall be positioned clear of the damper and at a position where the air stream is flowing evenly along the duct. Rubber plugs shall be provided to seal test holes.

The contractor shall provide sufficient access doors for the purpose maintenance and inspection. Access doors shall be of the hinged type or door openings in the ductwork shall be adequately stiffened and made airtight with purpose made rubber gaskets around the door perimeter.

## **4.0 DAMPERS**

Volume Control Dampers shall be fitted in all branch ducts and shall be of Multi leaf opposed blade construction.

## **4.1 FANS**

Fans shall be capable of the performance indicated in the schedules. Although the value of the resistance to airflow is indicated for the systems this does not relieve the Contractor of the responsibility for providing fans capable of delivering the required air volume through the system. Air supply fans shall have a replaceable filter assembly, anti vibration mountings and shall be supplied with direct on line starters of suitable rating incorporating over current and under voltage protection. The fans shall have an enclosure of IP 65 and shall be of Vent Axia make.

The make and design of the fans and attenuators shall be as indicated in the schedules. If no particular make of fan is indicated, the Contractor shall submit full details of the fan including the drive and motor together with supporting evidence from the manufacturers of noise levels and efficiencies to the Architect for approval.

Belt driven fans shall be fitted with pulleys suitable for V belts all as specified.

Machine bolts, nuts and washers only shall be used, for assembly of fans. All bearing surfaces for the heads of bolts or washers shall be counterfaced.

Holding-down bolts for fans and motors shall be square section under the head or be fitted with snugs to prevent them turning in the baseplate when the nuts are tightened.

Any fan which is too large or too heavy for sale handling shall be fitted with lifting eyes or other lifting facilities to enable mechanical lifting equipment to be used.

## **5.0 GRILLES, DIFFUSERS AND LOUVRES**

### **5.1 General**

These shall be of the type specified in the schedules positively and firmly located within the ductwork system. The Contractor shall provide the necessary air seal between grille and structure in all cases. The Contractor shall provide all accessories for connecting/adapting the diffusers/grilles to the ductwork.

All diffusers connected to ducting shall be provided with integral dampers.

Fixing screws that are visible shall be of a non rusting type, the colour and type to be agreed with the Architect.

### **5.2 Louvres**

The contractor shall supply and install at the termination of fresh air and exhaust air ducting at the external walls louvered inlets and outlets with insect proof screens.

Louvres shall be of robust extruded aluminum alloy section or hot dipped galvanized mild steel construction as indicated in the schedules. The finish shall be to Architect's approval. The louvres shall have specially designed water shedding blades and shall be fitted with a galvanized steel wire mesh screen of 20mm diamond mesh and at least 2mm diameter wire, mounted in a frame of galvanized steel rod with securing lugs or flat galvanized mild steel. Flanges shall be fitted with a returned edge, drilled for screw fixing.

### **5.3 Air extract grilles**

All supply and extract grilles shall be constructed from aluminium alloy or mild steel, with a finish of approved colour. Flanges shall be fitted with a return edge, complete with plastic foam or sponge rubber sealing gasket. The grilles shall be suitable for fixing to timber grounds, mild steel or plastic ducting. All grilles shall incorporate an aluminium alloy or mild steel opposed blade, volume control damper adjustable from within the ventilated space without grille removal. Two sets of volume and pattern adjustment keys shall be handed to the Engineer.

### **5.4 Air supply diffusers**

All air diffusers shall be constructed from aluminium alloy or mild steel and shall be of the sizes and suitable for the operating conditions indicated in the schedules. All diffusers shall incorporate an aluminium alloy or mild steel volume control damper adjustable from within the ventilated space without the removal of any part of the diffuser.

Two sets of volume control damper keys shall be handed to the Engineer.

### **5.5 Transfer grilles**

Transfer grilles shall be of the sizes and suitable for the operating conditions indicated in the schedules. The grilles shall be manufactured from aluminium or mild steel with an approved finish. The grilles shall be sight proof and rattle free with a flange frame auxiliary frame for the reverse side.

### **5.6 Finline Linear grilles**

Continuous line grilles shall be installed where indicated on the Drawings, and to the dimensions indicated in the schedules.

The grilles shall be fabricated from aluminium extrusions and all the components shall be mechanically interlocked to give a blemish free appearance. Where the overall length of the grille is greater than the standard manufactured length it shall be made up of sections which shall butt together to give hairline joints. Keyways and splice plates to facilitate the jointing shall be provided by manufactures.

The grilles shall have flanges not less than 25mm in width return edges. The grilles shall be held in position with concealed fasteners.

### **5.7 FIRE DAMPER**

Fire dampers complying with BS 476 and CP 413 shall be installed in the ducting as per Contract Drawings. The spindles of the dampers shall be placed off centre. When the fusible links melt, the dampers close automatically.



## **List of Reference Documents**

Standard Bidding Document for the Procurement of Works issued by PPDA, June 2003

Standard Bidding Document for the Procurement of Services, issued by PPDA, June 2003

FIDIC publication - Construction Contract (updates to Red Book)

FIDIC publication - Works of Civil Engineering Construction (Red Book)

FIDIC publications - Tendering Procedure, Contract Guide, Consultant Selection,

The Building Control Bill, 2012

World Bank publication - Procurement Guidelines under IBRD Loans and IDA Credits

African Development Bank publication - Disbursement Handbook

African Development Bank publication - "Project Cycle", dated 2004

EU publication - Guide to Procurement, dated 2002

Agreement and Schedule of Conditions of Building Contract, published July 1998 jointly by Architectural Association of Kenya, East Africa Institute of Architects, East African Section of the Institution of Structural Engineers, Kenya Association of Building and Civil Engineering Contractors, Federation of Contractors' Association (East Africa), Uganda society of Architects, Joint Building Council, Kenya