



USAID'S MALARIA ACTION PROGRAM FOR DISTRICTS

**THE PROPOSED RENOVATION WORKS AT
WABUSANA HEALTH CENTRE III**

Procurement Ref: MAPD/005/2020

Bidding Documents for Works

- Volume 1: Solicitation Document**
- Volume 2: Technical Specifications**
- Volume 3: Drawings**
- Volume 4: Bills of Quantities**

VOLUME 2: TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS

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 in Volume 1, Solicitation Document, 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 Volume 1, Solicitation Document, 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 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 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.

1.10 Tests

The Project Manager shall be at liberty to make all tests necessary in order to satisfy him 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.

1.11 Payment for Tests

The Contractor shall keep an accurate record of the costs incurred in the successful

testing of concrete work cube tests and other materials and such costs will be adjusted in the final account.

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.

1.12 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.

1.13 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.

1.14 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.

1.15 Overtime or Night work

If the Contractor determines for the purpose of expediting the Works or for any other

reason to permit the working of overtime or night work 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.

1.16 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.

1.17 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.

1.18 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.

1.19 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.

1.20 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.

1.21 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).

1.22 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.

1.23 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.

1.24 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.

1.25 Sheds for Operatives

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

1.26 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.

1.27 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.

1.28 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.

1.29 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.

1.30 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.

1.31 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.

1.32 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* to provide such a supply.

1.33 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.

1.34 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.

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.

1.35 Keeping and Delivering Site and Works Clean

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.

1.36 Contingencies

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 Definition 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 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.

3.7 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.

3.8 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.

3.9 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^3 in trenches.
- (ii) Exceeding 1.25 m^3 in general excavation

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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 authorized in writing by the Project Manager be paid for this at rates to be agreed for the use of such pumps.

3.16 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, blinding with fine stuff to receive concrete or other topping.

3.17 Temporary Retaining Boards

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

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.

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.

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”.

4.4 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.

4.5 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.

4.6 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.

Table for Concrete grade: Compressive strength and modulus of elasticity of concrete (N/mm²)

Grade	Characteristic compressive strength at 28 days (N/mm ²)		Cube strength (N/mm ²)		Characteristic tensile strength at 28 days (N/mm ²)	Modulus of elasticity at 28 days (N/mm ²)
	28days	7days	28days	7days		
15	15	12	18	14.4	1.1	25x10 ³

Grade	Characteristic compressive strength at 28 days (N/mm ²)		Cube strength (N/mm ²)		Characteristic tensile strength at 28 days (N/mm ²)	Modulus of elasticity at 28 days (N/mm ²)
20	20	16	24	19.2	1.3	27x10 ³
25	25	20	30	24	1.5	29x10 ³
30	30	24	36	28.8	1.7	32x10 ³
40	40	32	48	38.4	21	35x10 ³
50	50	40	60	48	2.5	37x10 ³

4.7 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.

4.8 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.

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.

4.9 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.

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.

4.10 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.

4.11 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.

4.12 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.

High tensile steel reinforcement shall be as specified in BS 449.

Fabric reinforcement shall be hard drawn steel fabric reinforcement in accordance with BS 4483.

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.

4.13 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

4.14 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.

4.15 Fixing and Assembly of Reinforcement

All reinforcement shall be accurately placed, fixed and maintained in the positions shown on the drawings.

4.16 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.

4.17 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.

4.18 Formwork

The term formwork shall include for any material or mold 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.

4.19 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.

4.20 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.

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
2500 onwards	As	indicated	on drawings

All reinforcement in lintel 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.

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

4.21 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.

4.22 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.

4.23 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 slab is poured.

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).

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 Walling

5.2.1 Locally Burnt Clay Bricks

Bricks shall be locally burnt clay bricks from a local source and samples shall be submitted for the Project Manager's approval.

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.

Table 5.2.3.1: Minimum Compressive Strength of Concrete Blocks

Block	Minimum Compressive Strength	
	Average of 10 Blocks N/mm²	Individual Block N/mm²
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.

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 local brickwork shall be built in Header or Stretcher bonding depending on the thickness required.

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 perpend, 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.

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

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.

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 consist of “Perspex” or similar approved translucent plastic corrugated sheeting.

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”.

7.2 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, cryptotermes and other timber pests. All cut ends of timber so impregnated shall be treated with two coats of “B” crystals or other approved method.

7.3 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
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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.

7.4 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.

7.5 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.

7.6 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.

7.7 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.

7.8 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.

7.9 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.

7.10 Nails and Bolts

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

7.11 Roofs

The roofs shall be constructed in accordance with the details 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.

7.12 Fixing Slips and Plugs

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

Where work is described as “plugged” it shall be fixed with nails to treated hardwood plugs inserted into the brick or block work joints.

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.

7.14 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”.

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

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 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.

8.11 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.

8.12 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.

8.13 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.

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

8.15 Moulding

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

8.16 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”

8.17 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.

8.18 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.

8.19 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.

8.20 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

8.21 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.

8.22 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.

8.23 Inspection

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

8.24 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.

8.25 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.

8.26 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 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.

8.27 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.

8.28 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.

8.29 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 indicated 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 or 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. Cement and Sand Paving

The mix for floor screed shall consist of one part cement and three parts sand as described by volume (1 : 3).

After placing and leveling the topping shall be finished with wood float or steel trowel so as to produce a uniform, dense and hard surface. 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.

Screeds to receive other floor finishes shall consist of cement and sand (1:3) and shall be laid in a similar manner as described for paving above.

10.6. 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 troweled 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.

10.7 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.

10.8 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.

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.

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 arises 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) 1stCoat – Cement and sand (1: 5 by volume), allowed to dry out thoroughly and well scratched to afford a key for the second coat.
- b) 2ndCoat – Cement and sand (1: 5 by volume), 6mm thick, finished true and level with a wood float.
- c) 3rdCoat – 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 troweling 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, 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.

11.10 Insulation Boards

Insulation boards, which include gypsum board, soft board, chipboard and plywood, 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.

11.11 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.

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 Bills of Quantities.

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.

12.4 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.

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) 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.

(ii) 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.

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 re-fixed 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.

MECHANICAL INSTALLATIONS

1.0 FIRE EXTINGUISHERS

1.1 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.

1.2 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.

PLUMBING INSTALLATIONS

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 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 manufacturer's recommendation with provision for expansion, including all necessary fittings and accessories. The pipe shall be tested at 15bars for one hour, immediately after the preliminary test, the maintest 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

1.3uP.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.

1.4 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.

1.5. 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.

1.6 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.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 Waste-Pipes and Waste Water Fittings

- (a) Waste-pipes, fittings and overflow pipes shall be made of approved Upvc pipes.
- (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.
- (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

ELECTRICAL INSTALLATIONS

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.

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- 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 to match existing:

- 2.1 Complete installation and all necessary conduits for surface and flush mounted installations and cabling of 400/ 230V networks.
- 2.2 Checking of existing Main Distribution Board (MDB), all Sub Main Distribution Boards (SMDBs), Final Distribution Boards (FDBs) and motor control centers (MCCs).
- 2.3 Checking of existing earthing and lightning protection systems.
- 2.4 Complete replacements of all existing luminaires to match existing.

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.

4.0 STANDARDS AND SPECIFICATIONS

- 4.1 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.
- 4.2 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.
- 4.3 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.
- 4.4 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.

- 4.5 No order shall be placed by the Contractor for major equipment unless written approval of the Project Manager has been obtained.
- 4.6 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.
- 4.7 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.
- 4.8 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.
- 4.9 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.

5.0 CONDUITS FOR INTERNAL WIRE DRAWING

- 5.1 All metal conduits shall be medium gauge and shall be laid in straight and symmetrical lines. 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.
- 5.2 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.
- 5.3 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.

6.0 CABLES (SINGLE AND MULTI-CORE) AND CONDUCTORS

6.2 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.

6.3 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.

7.0 WIRING ACCESSORIES, SMALL EQUIPMENT AND MATERIAL

- 7.1 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.
- 7.2 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.
- 7.3 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.
- 7.4 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.
- 7.5 Socket outlets shall be switched type as required, and of the type and rating where indicated and may have pilot lamps where required.
- 7.6 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.
- 7.7 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.
- 7.8 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.

- 7.9 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.
- 7.10 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.

8.0 LUMINAIRES AND LAMPS

- 8.1 Luminaires shall comply with BS 4533 and installed as specified the Bill of Quantities.
- 8.2 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.
- 8.3 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.
- 8.4 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.
- 8.5 Unless otherwise indicated, fixed luminaires shall be Class I and hand lamps shall be Class III rated at 50 volts.
- 8.6 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.
- 8.7 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.

9.0 LIGHTNING PROTECTION AND EARTHING

9.1 The lightning protection installation shall be in accordance with the recommendations of the British Code of Practice as set out in BS 6651-1985.

9.2 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.

9.3 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 check existing lightening protection and earthing systems and submit a detailed report to the Project Manager.

10.0 INSPECTION, TESTING AND COMMISSIONING

10.1 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.

10.2 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

10.3 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.

SOLAR PHOTOVOLTAIC (PV) POWER SUPPLY SYSTEM MODULES AND BATTERIES

5.1 Scope

This section of the regulation gives guidance on safe installation and utilization of photovoltaic power supply system as an alternative source of energy.

5.2 Photovoltaic (PV) Modules

5.2.1 PV Modules (Panels) Specifications

1. The output current and voltage of the modules or panels shall be appropriate for the application, and shall be clearly established by the contractor from the manufacturer's documentation and stated in the contract. The pertinent conditions are solar radiations of 1 KW per sqm or less and cell temperature of 35°C or higher.
2. The Uganda National Bureau of Standards is able to provide advice on quality and finish of panels, and can test new panels under local conditions where necessary.
3. The module shall have a quality mark from PV GAP or any other Accredited Testing Laboratory on the module. This mark provides assurance that the module has been tested to IEC 61215 or IEC 61646 and that the manufacturing has ISO 9000 certification and periodic auditing.

5.2.2 PV Modules Position

1. No object (trees, buildings, etc.) should shade any part of the PV-panel at any time of the year between 90 minutes after sunrise and 90 minutes before sunset.
2. Should shading be unavoidable, this shall be compensated for by reducing the daily energy output in the system design. Note that

reduction in output due to partial shading will typically be much greater than the portion of the array that is shaded.

3. Where possible, the PV-panel shall be installed on the roof of a building near the controller and battery bank.

5.2.3 PV Modules Orientation

1. The panel must be installed facing due north/south, at an angle of between 10 and 20 degrees to horizontal plane.

5.2.4 PV Modules Lighting Protection

1. PV-panels shall be installed lower than the highest point of the building.
2. The support frame shall be provided with a short lightning rod if this becomes the highest point of the building.
3. The UNBS or other specialized contractors will provide expert advice in case of doubt.
4. The contractor should make the client aware of the risks that can arise due to unsafely earthed structures. Where grounding of structures for lightning protection is needed a minimum of 16mm² cable shall be connected to a 1.5m earth rod.

5.2.5 PV Modules Support Structure

1. The support structure for panels shall be made of permanent materials, be strong enough to withstand all climatic conditions (wind, heat, water) without deflection or vibrations and be securely braced and fixed to the roof or the wall of a building or the ground.
2. Frames, support structure and other metal parts shall be made of non-corroding materials, or protected against corrosion by galvanization, painting, etc. as appropriate for the material used. It is good practice to

keep dissimilar metals separate, unless they are well sealed against water by paint or sealing compound.

3. Calculations and supporting documentation to demonstrate adequate design may be required.

5.2.6 PV Modules Roof Mounting

1. Fixing to roofs shall be done so that leakages are prevented and no corrosion of roofing materials will occur.
2. Bolts to be fixed through top of corrugations on corrugated metal roofs, to be secured to purlins, or special supports to be fixed to the roof structure if the purlins are of poor quality.
3. All holes in the roofing shall be thoroughly sealed and made waterproof with UV- resistant silicone sealant or suitable sealing compound.

5.2.7 PV Modules Ground Mounting

1. Solid foundations shall be provided at each corner of the array with additional support as required by the design of the supporting structure.
2. Panels shall not be mounted closer than 0.8m from the ground to avoid shading by grass and other vegetation.
3. Small arrays may alternatively be fixed to a single pole, securely buried into the ground and if necessary secured with stays.
4. The location shall be chosen such that no damage can be caused by animals (and the site shall be fenced).
5. This method of mounting should be avoided whenever possible.

5.3 Batteries

5.3.1 Type

1. Batteries shall be of a design suitable for PV applications. Deep discharge and long cycle life batteries are recommended.
2. Conventional car/truck starter batteries are not generally acceptable. For specifications of batteries, refer to US 149-1: 2000 Specification of batteries for photovoltaic systems.
3. The technical implications of the choice of battery and the costs and benefits of different types should be explained to the client in general terms.

5.3.2 Installation

1. Batteries shall be installed in boxes, racks, or cupboards to protect the connections (terminals) against accidental short-circuiting while still being checked.
2. At least 20mm free space shall be left between the batteries, the wall, and the top of the box.
3. Ventilation of the enclosure shall be ensured to avoid build up of explosive gases during charging.
4. The box shall be made of suitable durable materials and if made of wood, it shall be well preserved against insects (termites), rot and acid.
5. The box shall be securely fixed in position and each battery shall be marked with the date of manufacture and year and month of installation by the installer.
6. Maintenance requirements shall be clearly laid out in the owner's manual.

5.3.3 Controllers and Circuit

1. Controllers shall be designed and installed to protect the batteries against overcharging, as well as over-discharging.
2. Voltage disconnect/reconnect settings shall depend on the type of battery.
3. The rated capacity of the controller shall be selected to handle the maximum short circuit current from the PV-array and the maximum load.
4. The charge controllers and circuit breakers / fuses shall bear manufacturers PV quality mark, PV GAP or any other Accredited Testing Laboratory PV Quality Mark.
5. This quality mark provides the assurance that the module has been tested by an Accredited Testing Laboratory to IEC 61215 or IEC 61646, and that the manufacturing has ISO 9000 certification and periodic auditing.
6. A warning system consisting of a light and or an audible alarm providing at least three minutes advanced warning of disconnection should be installed.
7. Where the controller is installed in a room which is not regularly used, a remote alarm shall be installed at a place where it can be easily noticed.
8. Essential Service (ES) circuits may be provided with a switch to facilitate bypass of the over- discharge protection or to bypass the regulator completely.

9. Warning for low battery shall however be included as for Non-Essential Services (NES).
10. The owner's manual and markings on the bypass device shall clearly indicate the implications and potentially irreversible damage that may be caused by bypassing this protection.
11. The system shall be protected against damage due to accidental short-circuits by use of fuses or circuit breakers.
12. Any consumer circuits shall have circuit breakers.
13. Individual circuits from the battery shall have a maximum rated capacity of 25 amperes where not otherwise specified
14. Each circuit shall be so designed that the peak demand does not exceed 80% of the rated capacity of the fuse or circuit breaker.
15. Required fuses and circuit breakers may be integrated in the controller box or installed separately in a fuse or distribution box positioned near the controller and battery.
16. Each fuse or circuit-breaker shall be clearly marked with rated capacity and for which circuit it is used.

5.4 Samples

1. Where new components or of innovative techniques, are used by the contractor samples of materials and equipment shall be submitted for approval before installation commences. It is recommended, where possible, to show the client an existing installation so that any ambiguities may be explained.

5.5 System Design - Essential and Non- Essential Service (ES and NES)

5.5.1 Design data

- i. The client may provide data for dimensioning of each system where the design is not prepared in detail by the contractor.
- ii. It shall be the responsibility of the contractor to ensure that such system details are consistent with the:-
 - a) Type of lights and appliances
 - b) Essential Services (ES)and Non-Essential Services (NES)
 - c) Daily Load (DL)
- iii. The contractor shall specify the manufacturer, types of equipment with relevant rated capacities to be installed and enclose calculations and other documentation to prove that all requirements are met.

5.5.2 Calculations

1. Calculations of requirements for a functional system shall depend on whether it is considered NES or ES.
2. The system sizing rules are based on mathematical modeling with daily solar radiation records from Uganda over the period of at least 5 years, taking into account panel degradation as well as battery ageing.
3. Essential Service (ES) and Non- Essential Service (NES) systems should in general be installed as totally separate systems.
4. Where a combination of ES and NES are connected to the same system, it shall be sized as if all services are ES, unless particular calculations are provided to prove that the design of all combined system will satisfy the requirements to both types of services

5.5.3 System Autonomy

1. The period of autonomy of a Photovoltaic system may be defined as the total period for which the system shall provide power to its regular load without solar energy input. In other words, this is the period for which the system will operate normally without sunlight.
2. The autonomy of a system depends mostly on the depth of discharge of the batteries under normal daily loads and the number of batteries included in the system.
3. If a battery is only discharged by a small fraction of its total capacity each day, it will clearly provide more days of operation than a battery that is discharged by a large fraction each day.
4. The overall life of a battery is affected by the depth of its regular daily discharge; the life being inversely proportional to the depth of discharge (i.e. the shallower the discharge the longer the battery life).
5. The contractor shall give careful consideration to the sizing of the batteries in relation to the system load requirements. The cost implications of this should be presented clearly to the client

5.5.4 Essential Services (ES)

1. The battery capacity shall be at least 5 times the maximum daily load in Ah. This provides a normal cycle depth of 20% or less, assuming ample battery service life, and will provide 5 days autonomy in case of total array failure.
2. The array output current / in amperes under conditions as specified above shall be at least $DL (Ah)/4(h)$.

5.5.5 Non-Essential Services (NES)

1. The total nominal capacity of the batteries in Ah shall be at least 4 times the daily load in Ah.
2. The array output current; in amperes under conditions as specified above shall be $DL (Ah)/4(h)$.

5.6 Labels

1. Supply and fixing of labels shall be carried out by the contractor.
2. Labels shall be made of; permanent inerasable material with clearly legible letters and shall be displayed in a prominent position(s), providing the following information.

a) Battery enclosure:

"Danger!" "Explosive gas". "Do not smoke". "Do not use open flames". "Do not short circuit battery terminals!"

b) At Controller

- i) Name and address of electrical contractor responsible for installation
- ii) Date of installation
- iii) How to read performance (display or coloured lights)
- iv) Operation of circuit breakers or fuses (replacement of fuses)
- vi) Identification of circuits from the controller
- vii) Instructions on maintenance/cleaning of photovoltaic panels.

c) Distribution Board (if using wiring for 240V a.c.) the following phase shall be clearly indicated- "Use 12 Volt appliances only".

d) Remote Warning if is installed, shall have an explanation of the warning signals.

- e) At main entrance to building or home, the following text in English and/or Swahili, or any other appropriate local dialect shall be clearly marked "Please save energy. Switch off lights and appliances when leaving room".

5.7 Inspection and Testing

1. On completion of installation the system shall be inspected to ensure expected operation.
2. In addition to checking that all parts are correctly installed and operating satisfactorily, the electrician will certify in writing that:
 - a) Voltage drop (loss) in cables does not exceed specifications
 - b) Output from PV modules is within 5% of manufacturer's specified value
 - c) All wiring has been installed in an appropriate manner
 - d) No safety hazards exist
 - e) All signs and labels have been sensibly placed

5.8 Maintenance, Spare Parts and Warranties

1. The contractor shall be liable for all repair or replacement as per the installation warranty that he will provide.
2. Spare parts and expertise for maintenance and repair shall be made available by the contractor for the equipment after expiry of the warranty period.
3. Cost shall be separately detailed in the original quotation
4. Notwithstanding any third party warranties that may be passed on by the contractor, the minimum warranty period of some important system components shall be as follows:

Components	Minimum warranty
Light bulbs	1 year
Batteries	1 year
PV modules and Wiring to PV modules	5 years
Controller / Inverter	3 years
Complete system	1 year

5.9 Registration, Approval and Acceptance for Photovoltaic Installations

1. Registration of Contractors for photovoltaic installation shall be carried out by the Uganda National Bureau of Standards (UNBS).
2. The UNBS shall issue certificate of registration to the registered Contractors who will then be entitled to use the title and logo of "UNBS Approved Contractor" in their Company and promotional literature.
3. The certificate shall be issued subject to a nominal certification fee, and shall be uniquely numbered with the contractor's number.
4. The certificate shall remain the property of the UNBS, as the agent for the Code of Practice control body.
5. The Code of Practice Control Body will reserve the right to publicize all newly approved contractors in the public media in Uganda.
6. All contractors shall be required to maintain numbered records of all Photovoltaic installations they perform. Such records shall include the date, system type, unit installed, serial number, etc.
7. All contractors shall be required to inform the UNBS the date, type and system details of all new installations, but need only refer to their own internal reference number. Such detail may not include commercial or financial information.

8. The Control Body shall at random select installations from each contractor by these reference numbers for follow up inspections. It is planned to inspect one installation per year for each approved installation.

5.10 Field of Application

1. This code shall be read in conjunction with the relevant parts of the current IEE Regulations for Electrical installations, and shall apply to installation of direct current (d.c.) Photovoltaic (PV) energy systems.
2. This code has been drafted for 12V and 24V systems for residential applications, the so-called Solar Home Systems and is not intended to be used for other PV systems such as PV- pumping systems and grid -connected systems.
3. The application of this Code of Practice shall include everything necessary to provide lights and outlets for power as part of a photovoltaic power system.
4. Where drawings or instructions are not specified, then they shall be specified by the client, or as shown on the contractors drawings, including PV-panels, batteries, controllers, fuses and/or circuit breakers, switches, socket outlets, wiring, appliances, etc., The work shall also include repair of all damages to buildings and grounds caused by the installation where not otherwise specified by the client.

5.11 Installation Design

1. Where the layout of the installation is shown in drawings or detailed specifications are given, these shall be accurately followed.
2. Where no detailed drawings are provided, the installation shall be designed as efficiently as possible to minimize the loss of energy through cables and junctions.

3. A system design specified for a client by a contractor should be in a form that may be readily explained to a non-technical client.
4. This design information should be kept on file by the contractor, and may prove useful after completion of the installation in case of any subsequent dispute.
5. In the case of a client-specified installation, it is the responsibility of the contractor to inform the client of any areas that do not conform to this Code of Practice.
6. The contractor is entirely responsible for any deviations from the established code of practice and wiring standards.
7. Under no circumstances, even by client dispensation, shall any unsafe practice be acceptable. Written dispensation from the client should be obtained where necessary to protect the interests of the contractor.

5.12 Wiring Methods and Cables

5.12.1 Conduit Wiring

1. Surface mounted conduit with single wire conductors shall be installed using saddles or supports at suitable interval.
2. Conduits must be supported using saddles or supports. Drooping or unsupported runs shall be avoided.
3. PVC conduit may be used under floors but steel conduit should be used in all places where heavy or unpredictable loads may occur.
4. Under floor conduit should not be less than 19mm to allow for subsequent maintenance.

5.12.2 Cable Wiring

1. Surface mounted cables shall be installed using appropriate fasteners at suitable intervals to prevent sagging as shown on drawings.

5.12.3 Conductor Cross-section and Voltage Drop

1. The cross-sections of the conductors shall be according to Building Code "Code for Electrical Installations and Equipment in Buildings", APPENDIX 3 and the relevant tables in the IEE Wiring Regulations 16th edition.
2. The rated current carrying capacity at 35°C for any given wire cross-section shall not be exceeded. Wires of cross section area less than 2.5mm² are not recommended for use with photovoltaic systems.
3. The voltage across any appliance shall not be less than 5% volts of the battery terminal voltage. Under no conditions is a voltage of less than 10.5V permissible across an appliance. The voltage shall be measured with all appliances in the circuit, including those connected to socket outlets.
4. Voltage drop between the PV-panels and batteries shall not exceed 1.0V or 5% measured at maximum charging current. This voltage drop measurements will include any series or protection diodes.
5. To avoid using long cable runs with large numbers of T and star junctions, the load may be split into several circuits from the controller.

5.12.4 Use of Existing 240V AC Wiring

1. The existing wiring of 240V a.c. shall be used, provided it complies with other conditions in Clause 5.13.3 above.
2. If new wiring is installed in 240V a.c. conduits, it shall also be in accordance with IEE Wiring Regulations 16th edition for 240V a.c.

5.12.5 Cable Connections

1. Cables can be connected by the use of junction boxes, block connectors or soldering joints (with insulating sleeves).
2. All cable joints must be contained within a suitable junction box where they will be visible.
3. The rated capacity through the joints shall not be less than for the circuit they form a part of.
4. Lights, switches and sockets may be used as junction boxes where this is practicable.

5.12.6 Power Intake - Underground and Overhead

1. 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).
2. Underground cables shall be used across all areas with vehicular traffic and they may also be used for aesthetic reasons or to achieve a short cable run as instructed by the client.
3. The cables must be designed for this type of application and conduit must be able to withstand vertical loads if heavy vehicles are expected to cross the area.
4. Suspended cables shall be mounted so that the lowest point is at least 2.7m above ground level.
5. The cables shall be held in position by suitable brackets and strain relief to prevent mechanical wear and stress of the electrical connections.
6. Cables for outdoor exposed usage, shall be fully UV-resistant

7. Attachment of cables or conduit to concrete, bricks or mortar, walls etc. shall be made with appropriate fasteners and attachment of cables to metal or asbestos sheeting or similar material shall be made by use of suitable toggles.
8. Holes through roofing should be avoided where possible. Cables through roofing shall be contained in roof-entry boxes, which also shall form a waterproof seal to avoid leakage.
9. All holes for cables shall be drilled at top of corrugations. All holes in the roofing shall be thoroughly sealed and made waterproof with UV-resistant silicone sealant or equivalent.
10. Where wires or cables are fixed to or passing through particularly flammable materials (thatch, etc.) they should be shielded in non-flammable conduits.
11. Fittings must be fastened to suitable supports, which may need to be provided if not already present. No conduit or fitting should be attached directly to thatch, or any other non-supportive surface.
12. Holes for cables through walls shall be sealed with mortar or putty and the surfaces touched up with paint. Holes that penetrate external walls must slope downwards slightly towards the inside to prevent the ingress of water.

5.13 Workmanship and Finishing

1. Where no detailed specifications are provided by the client for choice of materials or workmanship, standard practice for the trade shall be followed.
2. Regarding the approval of quality, assessing capacity of PV-panels, batteries, controllers and other components, the client or contractor may

seek assistance from the Uganda National Bureau of Standards (UNBS), or from the Energy Unit of the Ministry of Energy and Mineral Development.

3. The installation shall include the completion and tidying up of any work that is a direct result of the installation. Any damage to surface walls or fittings caused by or as a result of the installation should be repaired by the contractor.

5.14 Light Fixtures

1. For general purpose and task indoor lighting, fluorescent lamps that comply with BS 1853 shall be recommended.
2. Ballasts for tubular fluorescent lamps shall comply with BS EN 60920 and 60921. Power factor correction shall be provided and this shall be not less than 0.85 lagging unless otherwise indicated.
3. Tungsten incandescent lamps that comply with BS 161 shall be used for particular tasks as required.
4. Halogen lamps in approved adjustable or portable fixtures shall be used for task light or spot light.
5. Where lamps are fitted next to thatched or flammable ceiling materials a metal lamp fitting or a metal shield shall be used to minimize the risk of fire.
6. For outdoor lighting such as security and street lighting, sodium vapour or other monochrome high intensity lamp shall be used.
7. Where there are insect's lamps with enclosures or defractors must be capable of being opened for cleaning by the client.
8. Where tools are necessary to open lamps for cleaning, such tools should be provided by the contractor as part of the installation.

5.15 Sockets

1. Socket outlets to be connected to solar PV system shall be designed for 12V d.c. and 2-pin plugs and shall not be possible to reverse the polarity.
2. Domestic appliances such as radios, fans spotlights, rechargeable torches, refrigerators and special instruments shall be connected to the solar PV system through socket outlets designed for such voltage or provided with suitable and efficient adaptors or inventers.
3. Any 12 V appliance shall not have a 240V a.c. mains type plug attached to it.
4. Where 240V outlets from a d.c.-a.c. inverter are provided, mains type socket shall be used and a label on each socket shall be added to show the maximum power available from that socket.
5. All wiring in these circuits shall conform to IEE wiring regulations for 240V a.c. mains wiring
6. Circuit breakers and proper earth safety system shall be provided to prevent damage to the inverter in case of an overload.
7. All installations that have d.c. sockets shall be wired so that the large diameter pin in the plug is always positive.
8. All positive connections shall be made with red insulated wire and all negative connections with black insulated wires.

5.16 Switches

1. Standard switches for 240Va.c. shall not be used as an alternative to special switches for 12 V d.c. unless written approval from the manufacturer is obtained which shall include acceptable d.c. voltage and current limits.

2. All switches shall be rated at twice their expected current carrying load.
3. Where particularly required, special time switches, photosensitive switches, remote and relay switches shall be specified and these shall be of good quality and performance, as specified for each purpose.
4. All switches shall include a clear visual indication of their state.

5.17 Installation

1. The whole of the installation and components shall be in accordance with:-
 - a) The current edition of "Regulations for the Electrical Equipment of Buildings" issued by the Institution of Electrical Engineers.
 - b) Relevant British Standard specifications.
 - c) Relevant Uganda Government Legislation.