INTERGOVERNMENTAL AUTHORITY ON DEVELOPMENT (IGAD)

ICPALD

BID DOCUMENT

Construction of Proposed Poultry House at Akendayo, Benishangul-Gumuz Region(Ethiopia)

Ref: ICPALD/WRKS/AKEN/2/25

INVITATION FOR BIDS

Construction of Proposed Poultry House at Akendayo, Benishangul-Gumuz Region(Ethiopia)

SUBJECT: INVITATION FOR BIDS FOR THE CONSTRUCTION OF PROPOSED POULTRY HOUSE AT AKENDAYO, BENISHANGUL-GUMUZ Region(Ethiopia)_____

You are invited to submit your most competitive bid for the Construction of Proposed Poultry House at Akendayo, Benishangul-Gumuz Region(Ethiopia) to be contracted by IGAD CENTER FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT (ICPALD)

1. To assist you in the preparation of your bid, we are enclosing the following :

    i. Bill of Quantities
    ii. Description of the Works/Drawings
    iii. Instructions to Bidders

2. You are requested to provide your offer latest by Tuesday 13th May 2025, 04:00 pm

3. We look forward to receiving your bid and thank you for your interest in this project.

Instructions to Bidders

1. Scope of Works

ICPALD invites bids for the Construction of Proposed Poultry House at Akendayo, Benishangul-Gumuz Region(Ethiopia)

The successful bidder will be expected to complete the works within Sixty (60) days from contract signing. (Provide the proposed work plan/schedule)

2. Qualification of the Bidder:

(a) The bidder shall provide qualification information which shall include:-
(b) Total monetary value of construction works performed for each year of the last 3 years;
(c) Income tax clearance certificate;
(d) Report on his financial standing; and
(e) Details of any litigation, current or during the last 3 years in which the bidder is involved, the parties concerned and disputed amount or awards in each case.
(f) A copy of certificate of registration from the relevant Authority
(g) A copy of trading license;
(h) The bidder should have satisfactorily completed at least one similar works in the last three years. (Provide copy of the certificate of completion for the previous works)

2.1 Eligibility - Conflict of Interest*

Any Bidder found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest for the purpose of this bidding process, if the Bidder:

i. directly or indirectly controls, is controlled by or is under common control with another Bidder; or

ii. receives or has received any direct or indirect subsidy from another Bidder; or

iii. has the same legal representative as another Bidder; or

iv. has a relationship with another Bidder, directly or through common third parties, that puts it in a position to influence the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

v. any of its affiliates has been hired (or is proposed to be hired) by the Employer or Borrower as Engineer for the Contract implementation;

vi. has a close business or family relationship with the concerned professional staff of the project implementing agency

3. Bid Price

The contract shall be for the whole works as described in the Bill of quantities, drawings

a) The rates quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.
b) All duties, taxes and other levies payable by the contractor under the contract shall be included in the total price.
c) The rates quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.
d) The Bidder shall fill in rates and prices and line item total for all items of the Works described in the Bill of Quantities along with total bid price (both in figures and words). Items for which no rate or price is entered by the Bidder shall be deemed covered by the other rates and prices in the Bill of Quantities.

4. Submission of bids

4.1 The bidder is advised to visit the site of works at his own expense and obtain all information that may be necessary for preparing the Bid.

4.2 Each bidder shall submit only one Bid which incorporates the labor.

4.3 The set of bidding documents comprise of the following:

i. Layout Drawings of the works;

ii. Structural Details;

iii. Detailed Bill of Quantities;

iv. Technical Specifications;

v. Instructions to Bidders

vi. Draft Contract Agreement format which will be used for finalizing the agreement for this Contract.

4.4 The Bid submitted by the bidder shall comprise the following:-

a) Bid in the format given in Section **B**.
b) Signed and Stamped Bill of Quantities- to be filled in as attached;
c) Qualification information duly completed; and
d) Bid Security, in original form for the amount 2% of the total amoutin form of .
   - A bank guarantee issued by a nationalized/scheduled bank located in your home country in the form given in Section B; or Certified cheque or Bank draft payable to ICPALD

4.5 The bidder shall send the Bid via email addressed to:

beverlyne.nyanchera@igad.int with a cc to icpaldprocurement@igad.int

Samples may be requested by the engineer at any stage, they should be provided then.

4.6 Any Bid received by after the deadline for submission of Bids will be rejected.

5. Validity of Bid

Bid shall remain valid for a period not less than 120 days after the deadline date specified for submission.

6. Evaluation of Bids

Bids that are responsive, qualified and technically compliant will thereafter be ranked according to price. Award of contract will be made to the lowest evaluated priced Bid.

7. Information relating to evaluation of Bids and recommendations for the award of contract shall not be disclosed to bidders or any other persons not officially concerned with the process until the award to the successful bidder is announced.

8. Evaluation of Bids

IGAD will evaluate and compare the Bids determined to be substantially responsive i.e. which

(a) meet the qualification criteria specified in clause 2 above;

(b) are properly signed; and

(c) conform to the terms and conditions, specifications and drawings without material deviations.

9. Award of contract

IGAD will award the contract to the bidder whose Bid has been determined to be substantially responsive and who has offered the lowest evaluated Bid price and who meets the specified qualification criteria.

9.1 Notwithstanding the above, IGAD reserves the right to accept or reject any Bids and to cancel the bidding process and reject all Bids at any time prior to the award of contract.

10.2 The bidder whose bid is accepted will be notified of the award of contract by IGAD prior to expiration of the Bid validity period.

11. Performance Security

Within 15 days of receiving letter of acceptance, the successful bidder shall deliver to the ICPALD the performance security (either a bank guarantee or a bank draft in favour of the Employer) for an amount equivalent of 2% of the contract price. The Performance Security shall be valid till the expiry of the period of maintenance of the work, specified in clause 12.

Failure of the successful Bidder to furnish performance security and signing the agreement within the period stipulated shall constitute sufficient grounds for annulment of award and forfeiture of the Bid Security, in which case the Employer may make the award to the next lowest evaluated bidder or call for new bids.

12. Period of Maintenance:

The "Period of Maintenance" for the work will be three (6) months from the date of taking over the works. During the period of maintenance, the contractor will be responsible for rectifying any defects at no cost.

13. Payment:

Any payments for the works completed will be made against a certificated approved by the engineer designated by IGAD.

.....

SECTION B
FORMAT FOR BID

Description of the Works:

To:

Subject : Bid for .....

.....

Reference : Letter No.....dated.....from.....

Sir,

We offer to execute the Works described in your letter referred above in accordance with the Conditions of Contract enclosed therewith at a total Contract Price of –

USD _____ [in figures]

USD _____ [in words]

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We hereby confirm that this Bid is valid for 120 days as required in Clause 5 of the Instructions to Bidders.

Yours faithfully,

Authorized Signature : Date: _____

Name & Title of Signatory : _____

Name of Bidder : _____

Address : _____

1. Performance Security

[The Bank, as requested by the successful Bidder, shall fill in this form in accordancewith the instructions indicated]

Date: ***[insert date (as day, month, and year) of Bid Submission]***
Contract No. and title: ***[insert number and title of the contract]***

Bank's Branch or Office: ***[insert complete name of Guarantor]***

Beneficiary: ***[insert complete name of Contracting Authority]***

PERFORMANCE GUARANTEE No.: ***[insert Performance Guarantee number]***

We have been informed that ***[insert complete name of Contractor]*** (hereinafter called "the Contractor") has entered into Contract No. ***[insert number]*** dated ***[insert day and month], [insert year]*** with you, for the supply of ***[description of Goods and related Services]*** (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a Performance Guarantee is required.

At the request of the Contractor, we hereby irrevocably undertake to pay you any sum(s) not exceeding ***[insert amount(s[27]) in figures and words]*** upon receipt by us of your first demand in writing declaring the Contractor to be in default under the Contract, without cavil or argument, or your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This Guarantee shall expire no later than the ***[insert number]*** day of ***[insert month] [insert year]***,[28] and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

[signatures of authorized representatives of the bank and the Contractor]

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[27] *The Bank shall insert the amount(s) specified in the SCC and denominated, as specified in the SCC, either in the currency(ies) of the Contract or a freely convertible currency acceptable to the Contracting Authority.*

[28] *Dates established in accordance with Clause 17.4 of the General Conditions of Contract ("GCC"), taking into account any warranty obligations of the Contractor under Clause 15.2 of the GCC intended to be secured by a partial Performance Guarantee. The Contracting Authority should note that in the event of an extension of the time to perform the Contract, the Contracting Authority would need to request an extension of this Guarantee from the Bank. Such request must be in writing and must be made prior to the expiration date established in the Guarantee. In preparing this Guarantee, the Contracting Authority might consider adding the following text to the Form, at the end of the penultimate paragraph: "We agree to a one-time extension of this Guarantee for a period not to exceed [six months] [one year], in response to the Contracting Authority's written request for such extension, such request to be presented to us before the expiry of the Guarantee."*

2. Bank Guarantee for Advance Payment

[The Bank, as requested by the successful Bidder, shall fill in this form in accordance withthe instructions indicated.]

Date: *[insert date (as day, month, and year) of Bid Submission]*
Contract No. and title: *[insert number and title of the contract]*

[bank's letterhead]

Beneficiary: ***[insert legal name and address of Contracting Authority]***

ADVANCE PAYMENT GUARANTEE No.: ***[insert Advance Payment Guarantee no.]***

We, ***[insert legal name and address of bank],*** have been informed that ***[insert complete name and address of Contractor]*** (hereinafter called "the Contractor") has entered into Contract No. ***[insert number]*** dated ***[insert date of Agreement]*** with you, for the supply of ***[insert types of Goods to be delivered]*** (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, an advance is to be made against an advance payment guarantee.

At the request of the Contractor, we hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ***[insert amount(s)[29] in figures and words]*** upon receipt by us of your first demand in writing declaring that the Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than toward delivery of the Goods.

It is a condition for any claim and payment under this Guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account ***[insert number and domicile of the account]***

This Guarantee shall remain valid and in full effect from the date of the advance payment received by the Contractor under the Contract until ***[insert date[30]].***

This Guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

[29] *The bank shall insert the amount(s) specified in the SCC and denominated, as specified in the SCC, either inthe currency(ies) of the Contract or a freely convertible currency acceptable to the Contracting Authority.*

[30] *Insert the Delivery date stipulated in the Contract Delivery Schedule. The Contracting Authority should note that in the event of an extension of the time to perform the Contract, the Contracting Authority would need to request an extension of this Guarantee from the bank. Such request must be in writing and must be made prior to the expiration date established in the Guarantee. In preparing this Guarantee, the Contracting Authority might consider adding the following text to the Form, at the end of the penultimate paragraph: "We agree to a one-time extension of this Guarantee for a period not to exceed* ***[six months][one year]****, in response to the Contracting Authority's written request for such extension, such request to be presented to us before the expiry of the Guarantee."*

_____
[signature(s) of authorized representative(s) of the bank]

Draft Contract Agreement

This Agreement (hereinafter referred to as the **"Agreement"**) is made this ……..……..…

BETWEEN, IGAD Centre for Pastoral Areas and Livestock Development based in Nairobi, Kenya and of PO Box 47824 – 00100 (hereinafter referred to as **"ICPALD"** which expression where the context so admits includes its successors and assigns) of one part; **AND** ……..is a company incorporated in …….(hereinafter referred to as the **"Contractor"** which expression where the context so admits includes its successors and assigns), of the second part.

WHEREAS:

A. ICPALD being a Statutory Body of IGAD, established by an agreement between Member States and charged with the responsibility of development in the region wishes to engage ……. for the Construction following;

…….

B. ……. is experienced in such matters, able, competent and willing to carry out the works specified under Annex 3 of this Agreement

NOW THEREFORE, the Parties hereto agree as follows:

Clause 1 Definitions

Unless the context otherwise requires, the following terms whenever used in this Agreement, shall have the following meaning: -

(a) **"Applicable Law"** means the laws and other instruments having the force of law in the ……...

(b) **"Agreement"** means this Agreement and the attached annexures executed by the parties hereto now and any future addendum;

(c) **"ICPALD"** means the IGAD Centre For Pastoral Areas and Livestock Development, an approved agent of IGAD, authorised to take possession of the Works or supplies and administer to the related service requirements;

(d) **"Contractor"** means ……., its authorised personnel and equipment that is within its scope and control.

(e) **"Party"** means the ICPALD or the Contractor as the case may be and "Parties" means both of them;

(f) **"Works"** means the ……which are to be constructed by the Contractor pursuant to this Agreement.

(g) **"Officials"** means the persons stated under paragraph 1.4 or as may be specified from time to time.

1.1 Purpose

The purpose of this Agreement is for the Contractor to **……**

1.2 Laws Governing the Agreement

This Agreement, its meaning and interpretation, and the relations between the Parties hereto shall be governed by the Laws of the Federal Democratic Republic of Ethiopia.

1.3 Language

This Agreement has been executed in English, which shall be the binding and controlling language for all matters relating to the meaning or interpretation of this Agreement.

1.4 Notices

Any notice, request or consent made pursuant to this Agreement shall be in writing and shall be deemed to have been made when delivered in person to an authorized representative of the Party to whom the communication is addressed, or when sent by registered mail, telex, telegram, email or facsimile to such Party at the Address specified *herein below*.

CONTRACTOR:

ICPALD:

1.5 Location

……

1.6 Authorized Representative

Any action required or permitted to be taken and any document required or permitted to be executed under this Agreement by either Party may be taken or executed by the Officials as may be specified by the Parties, but the Contractor shall work under the technical guidance of the county engineer answerable to the ICPALD Director.

Clause 2 Commencement, Completion, Modification and Termination of Agreement

2.1 Execution of this Agreement

This Agreement shall come into effect upon the date of signature of the last party (herein known as the date of execution) and shall expire after ……..Calendar days unless otherwise extended by mutual agreement.

2.2 Contractual Term

Unless terminated earlier pursuant to Clause 2.5, this Agreement shall be valid from the date of its execution and shall remain enforce for a duration of ……..Calendar days unless subjected to renewal or extension on such terms and conditions as the case may require.

2.3 Modification

Modification of the terms and conditions of this Agreement, and any addendum, including any modification to this Agreement or the fees (if at all), may only be done by a written agreement between the Parties.

2.4 Force Majeure

2.4.1 **Definition**

For the purposes of this Agreement, "*Force Majeure*" means any event which is beyond reasonable anticipation and control of a Party and which makes a Party's performance of its obligations under the Agreement impossible or so impractical as to be considered impossible under the circumstances.

2.4.2 No Breach of Contract

The failure of a Party to fulfil any of its obligations under the Agreement shall not be considered a breach of, or default under this Agreement in so far as such liability arises from an event of *Force Majeure*, provided that the Party affected by such an event: -

a) Has taken all reasonable precautions, due care and reasonable alternative measures in order to carry out all the terms and conditions of this Agreement; and

b) Has informed the other Party as soon as possible about the occurrence of such an event.

2.4.3 Payments

The payment shall be made by ICPALD to the Contractor as described in the Clause 8.

During the period of inability to perform the obligations as a result of an event of *Force Majeure*, the Contractor shall not be entitled to be paid for arising expenses if any save as herein stated below.

2.5 Termination

2.5.1 **By ICPALD**

ICPALD may terminate this Agreement by not less than **Two (2) Working Weeks** written notice of termination to the Contractor, to be given after the occurrence of any of the events specified in paragraphs (a) through (d) of this Clause 2.5.1.

(a) If the Contractor does not remedy a failure in the performance of his obligations under the Agreement within **Two (2) Working Weeks** after being notified or within any further period as ICPALD may have subsequently approved in writing;

(b) If the Contractor fails to demonstrate the ability to carry out this assignment to the satisfaction of ICPALD within the agreed period or to the expected standard.

(c) If the Contractor becomes insolvent or bankrupt;

(d) If, as a result of *Force Majeure*, the Contractor is unable to perform a material portion of the Services for a period of not less than One (1) Week; or

(e) If the Contractor, in the judgment of ICPALD, has engaged in corrupt or fraudulent practices in executing this Agreement.

For the Purpose of this Clause:

"Corrupt Practice" means but is not limited to the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the selection process or in execution of obligations under this Agreement.

"Fraudulent Practice" means a misrepresentation of facts in order to influence a selection process for the execution of an agreement to the detriment of ICPALD, and includes collusive practice among service providers (prior to or after submission of quotations) designed to establish prices at artificial levels and to deprive IGAD of the benefits of free and open competition.

2.5.2 Notwithstanding anything else in this Agreement, this Agreement may however be terminated summarily without notice in case of gross misconduct or negligence of either professional or personal nature which include but are not limited to:

a. the other Party fails to perform any of its material obligations under this Agreement and does not rectify such failure within **Two (2) Working Weeks** of a written notice from the Terminating Party stating such failure; or

b. proceedings in insolvency, bankruptcy, corporate reorganization, winding up or any other similar procedure is initiated (or threatened) by or against the other Party, or a receiver is appointed over all or a material part of the business or assets of the other Party, or liquidation proceeding is commenced by or against the other Party; or

c. the other Party becomes unable to pay its debts generally as they become due; or

d. the other Party holds a meeting of creditors or makes a general assignment for the benefit of its creditors; or

e. the whole or material part of the business of the other Party is transferred to a third party by merger, amalgamation, agreement, order of court or otherwise, or the other Party ceases to do business

For the Purpose of this Clause:

"Gross misconduct" means but is not limited to the following circumstances:

any intentional act or series of actions which leads to a reasonably foreseeable outcome, and results in irreparable harm befalling ICPALD, its property or its personnel.

"Negligence" means but is not limited to the following circumstances:

any accidental act or series of actions which leads to a reasonably foreseeable outcome, and results in irreparable harm befalling ICPALD, its property or its personnel.

2.5.3 By the Contractor

The Contractor may terminate this Agreement by giving a written notice of not less than **Two (2) Working Weeks** to ICPALD, such notice to be given after the occurrence of any of the events specified in paragraphs (a) and (b) of this Clause 2.5.3.

(a) If ICPALD fails to pay monies due to the services provided pursuant to this Agreement and not subject to dispute within **Thirty (30) Calendar days** after receiving written notice from the Contractor that such payment is overdue; or

(b) If, as a result of "*Force Majeure"*, the Contractor is unable to perform a material portion of the Services for a period of not less than **Two (2) Working Weeks**.

2.5.4 Payment upon Termination

In the event of termination of this Agreement pursuant to Clause 2.5.1 or 2.5.2, ICPALD shall remunerate the Contractor for services duly performed prior to the effective date of termination.

Clause 3. Obligation of the Contractor

3.1 The Contractor shall perform the specifics as set out in the obligations to this Agreement, which include:

3.1.1 Ensuring all document surrounding the Works including but not limited to the materials supplied and it's are genuine and authentic.

3.1.2 Ensuring that the materials supplied in the construction of the Works are free from any lien, charge, hire purchase agreement or such instrument.

3.1.3 Guaranteeing that the materials supplied in the construction of the Works are free from any and all defects, either prior to or during the duration of this contract.

3.1.4 Guaranteeing that when the Contractor is carrying out the process of construction. That the Contractor will obtain the necessary permits (if required) and will exercise normal construction standards, as per the industry.

3.1.5 The Contractor should correctly supply the material necessary to construct the Works, as well as, items in support of the Works, and this includes but is not limited to; cables and other peripheral devices and installation services related to the equipment and/or the installation of peripheral devices. Furthermore, the Contractor shall bear the responsibility of rectifying any mistake or defect during the aforementioned process.

3.1.6 Ensuring that the Contractor exercises a reasonable standard of care, while the Works are in the Contractors custody up to and till delivery is completed.

3.1.7 Transferring ownership and control of the Works into ICPALD's custody upon Delivery and installation

3.1.8 Promptly informing ICPALD of any event or conditions, which might materially and adversely affect the transfer of the Works. This includes but is not limited to; fire, theft, damage or any such event in which the Contractor may, or may not be deemed to have contributed to the event.

3.1.9 Where fire, theft or damage occurs, the Contractor covenants to return the Works to its original state prior to the event, or refund monies paid back to ICPALD.

3.1.10 Processing the transfer of Works free from any taxes due and payable to the Federal Democratic Republic of Ethiopia.

Clause 4. Contractor Actions Requiring ICPALDs Prior Approval

The Contractor shall obtain ICPALD's prior approval in writing before entering into any subcontract for the performance of any part of this contract. Where the Contractor subcontracts part of the construction of the Works, the Contractor shall bear liability for

defect(s) caused by the subcontractor and/or injurious harm that is caused or befalls the subcontractor(s).

Clause 5. Obligations of ICPALD

5.1 ICPALD shall use its best efforts to ensure that the Contractor successfully Construct the housing units using the Works listed.

5.2 ICPALD shall make payment in the format prescribed in Clause 8.2 and upon the satisfaction of ICPALD is satisfied that it has passed a successful inspection.

5.3 ICPALD shall, if and when requested by the Contractor, secure a duly executed exemption from duty certificate in the favour of the Contractor.

5.4 ICPALD shall pay the Contractor the sum stated in Clause 8 of the Agreement as specified herein.

Clause 6. Change in the Applicable Law

If, after the date of this Agreement, there is any change in the Applicable Law in whatever respect the same shall not affect the agreed sums of payment herein.

Clause 7. Delivery

The Works will be considered to have been completed once all of the following conditions have been completed:

7.1. The Contractor has physically transported the materials necessary to construct the Works and items in support of the Works under this Agreement, and any other supplemental equipment to physical location requested by ICPALD.
7.2. The Contractor shall construct the Works on the sites requested by ICPALD.
7.3. The Construction has successfully been completed and approved by ICPALD, and that the Contractor shall hand over possession to ICPALD.

Completion of the works shall be expected on or before the expiry of this Agreement.

Clause 8. Contract Price

8.1 The Contractor shall be paid a sum of **……..**upon delivery without any other benefits.

8.2 The Contractor shall be paid the said amount in the format prescribed:

(i) **Payments against Progress**: The engineer, appointed by ICPALD will determine the satisfaction of works and the payments due as per the implementation progress and against a certified completion certificate signed by all the parties.
(ii) **Retention Fees:** 5% of the total cost will be paid after issuance of final acceptance certificate and upon the expiry of the defect liability period of six (6) months.

8.3 The Contractor shall be responsible for any related ancillary financial obligations, including but not limited to; taxes, clearing and forwarding, custom charges and any such related expenses.

Clause 9. Confidentiality

The Contractor may not communicate at any time to any other person, government or authority external to ICPALD any information known to him by reason of his association with ICPALD which has not been made public, except in the course of his duty or by authority of the Director of ICPALD or his designate; nor shall the Contractor at any time use such information for private purpose. This obligation shall not lapse upon termination of this Agreement with ICPALD for a period of two (2) years.

Clause 10. Indemnity

10.1 Each party (the "Indemnifying Party") shall be responsible for, and shall indemnify and hold harmless the other party (the "Indemnified Party") against claims in respect of loss or damage to property (excluding, for the avoidance of doubt, the Works supplied whether delivered or not) of, incurred by the Indemnified Party and its directors, and/or officers, employees resulting from the negligence or intentional act or omission of the Indemnifying Party in the performance of or otherwise in connection with this Agreement. Notwithstanding the foregoing, the aforesaid indemnity obligation of the Indemnifying Party shall be excluded to the extent of the Indemnified Party's negligence, and except for any claim arising out of or in relation to the Indemnifying Party's intentional act or omission or fraud, no party shall be liable for any special, incidental, consequential or indirect loss or damages, including, but not limited to, damages for loss of revenue.

10.2 This indemnity shall cease upon the termination or expiration of this Agreement.

Clause 11. Liability

Under no circumstances will the Contractor have any liability to ICPALD of whatever kind for

11.1 any defects resulting from wear and tear, accident, improper use by ICPALD of the said Works

11.2 the fitness of the Works for any purpose other than purpose under which it was constructed for;

11.3 any warranties other than those derived from the manufacturer;

11.4 any adjustments, modification or repairs outside of the default period to the Works

Clause 12. Settlement of Disputes

12.1 **Amicable Settlement**

The Parties shall use their best efforts to settle amicably any dispute arising out of or incidental thereto in connection with this Agreement or its interpretation.

12.2 Any dispute between the Parties as to matters arising pursuant to this Agreement that cannot be settled amicably within thirty (30) days after receipt by one Party of the other Party's request for such amicable settlement shall be submitted for Arbitration by either Party for settlement in accordance with the laws of the Republic of Kenya

Parties shall exhaust all avenues of conciliation and mediation before filing any proceedings to resolve any dispute.

Clause 13. Assignment

No Party may assign any of its rights, or delegate any of its obligations or duties under this Agreement without the prior written consent of the other Party.

Clause 14. Amendments and Waivers

No provision of this Agreement may be amended or waived, except in a writing signed by the Parties to be charged therewith.

Clause 15. Severability

If any of the provisions contained in this Agreement shall be declared invalid, illegal or unenforceable in whole or in part under any applicable law, the validity, legality and enforceability of the remaining provisions or part thereof shall not in any way be affected or impaired.

Clause 16. Entire Agreement

This Agreement (including the Annex) constitutes the entire agreement between the Parties in respect to the subject matter hereof and supersedes all previous negotiations and communications in respect thereto.

This Agreement and its annexures are stated in the sequences of documents below:

(a) the Agreement
(b) Letter of Acceptance,
(c) Contractor's Bid
(d) Bill of Quantities, Designs and Drawings

IN WITNESS WHEREOF the Parties hereto have caused their hands to be affixed the date month and year hereinabove shown in two originals.

For IGAD	**For Contractor**
Date	Date
Signature	Signature

Centre for Pastoral Areas and Livestock Development

Technical Specifications

Subject of Procurement: Proposed Poultry House at Akendayo, Benishangul-Gumuz Region (Ethiopia)
Procurement ReferenceNumber: ICPALD/WRKS/AKEN/2/25
Date of Issue: April 2025

TABLE OF CONTENTS

A. GENERAL SPECIFICATIONS

1.0 GENERAL NOTES

SPECIFICATIONS

1.0 GENERAL NOTES

(Including General Specifications and General Conditions)

NOTE: The Contractor is to allow in his rates for all expenses in connection with testing of materials as specified including the supply and preparation of materials to be tested, the cost of laboratory charges, etc.

"Equivalent of Standards and Codes and Brand Names"

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards of codes specified will be accepted subject to the Architect/Project Manager's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Architect/Project Manager at least 28 days prior to the date when the Contractor desires the Architect/Project Manager's consent. In the event, the Architect/Project Manager determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

2.0 GENERAL ITEMS

2.0 GENERAL ITEMS

2.1 Materials generally

All materials shall be new and of the qualities and kinds specified herein and equal to approved samples. Deliveries shall be made sufficiently in advance to enable samples to be taken and tested if required. No materials shall be used until approved materials which are damaged in any way shall be immediately removed from the site at the Contractor's expense.

2.2 Alternatives to proprietary brands or specified standards

Where materials are specified to a particular standard or by their proprietary names or where fittings are specified by catalogues, numbers or descriptions, the Contractor may offer alternatives which are of equal quality. In such event the tender must be qualified by listing the various alternatives to be used. The successful tenderer must then subsequently submit samples of the alternative materials to the Architect as soon as practicable after the award of the Contract, and must obtain his written approval before purchasing.

2.3 Measuring and testing equipment

The Contractor shall provide on the Site the following equipment for carrying out measuring and control tests and maintain the same in full working order, if relevant to the scope of the works:-

a) Straight edges 2 metres and 4 metres long for testing accuracy of finished surface

b) 150 mm Steel cube moulds with base plates and tamping rods to B.S. 1881.

c) Two 30 metres steel tapes.

d) One dumpy or quick set level and staff.

2.4 Minor details of construction

Minor details of construction which are fairly and obviously intended and which may not definitely be referred to in this Specification and/or Drawings, but which are usual in sound building practice and are essential to the Works, shall be considered as included in the Contract Sum.

2.5 Samples

The Contractor is to allow in his rates for all expenses in connection with testing of materials as specified including the supply and preparation of materials to be tested, the cost of laboratory charges, etc.

3.0 DEMOLITIONS AND ALTERATIONS

3.0 DEMOLITIONS AND ALTERATIONS

3.1 GENERALLY

The Contractor is required to visit the site of the existing building and ascertain for himself the nature of the works and no claim arising from lack of knowledge in this respect will be entertained. The dimensions and quantities given in this section are approximate and the Contractor is referred to the site to ascertain the exact nature of the work.

The items pulling down and alterations are to include for both labour and materials and for any shoring, needling and temporary works in connection therewith. The Contractor must allow in his pricing for making good all works disturbed in all trades and carting away all debris.

The Contractor must give all the necessary notices and must exercise due care in the demolitions. He must not collapse large sections of walls, floors, etc. and must provide all necessary shoring and supports during the demolitions.

During demolition the Contractor shall keep the debris constantly watered to minimize the dust arising and this shall be included in his prices.

All materials arising from the demolitions, unless specifically stated otherwise, are to become the property of the Contractor and any credit allowed for the value of such materials shall be shown in the space provided, if any or valued and negotiated with the Project Manager.

All materials, including rubbish, shall be removed from the site as soon as possible.

The Contractor is to erect dust-proof screens to the approval of the Project Manager where deemed necessary and to remove them on completion of the works, all to the Project Manager's satisfaction. Such screens shall be deemed to have been priced for.

3.2 INTERPRETATION OF TERMS

a) "Demolish" shall be deemed to mean cutting away, breaking up, demolishing, pulling down, taking down, removing, etc., as the context requires and shall include in all cases temporarily strutting and supporting and making good remaining works as necessary, and clearing away and removing from site all debris, etc.

b) "Remove" shall be deemed to mean taking down, hacking up, breaking down, removing,
etc., and clearing away from site and all other expenses thereby entailed.

c) "Making good" shall be deemed to mean all making good, fitting, facing up, plastering,
repairing and repainting of match existing work.

d) "To match" shall mean to be equal to relevant existing work in design, workmanship and all other respects.

e) "Re-fix" shall apply to existing materials arising from the works and shall mean take from store and fix in new position, including making good, repairing and adjusting as necessary.

4.0 EXCAVATIONS AND EARTHWORKS

4.0 EXCAVATIONS AND EARTHWORKS

4.1.0 STANDARDS AND CODES OF PRACTICE

The Contractor shall comply with requirement of the following codes of practice:-

4.1.1 Codes of Practice:

a)	Site investigations	C.P. 2001
b)	Earthworks	C.P. 2003
c)	Foundations	C.P. 2004
d)	Protection of building against water from the ground	C.P. 102
e)	NOTE:	The Contractor's attention is drawn to section "D" of The Standard Method of Measurements for Building Works.

4.2.0 GENERALLY

4.2.1 Visit to the Site

The Contractor shall visit the site and ascertain for himself the nature of the soil to be excavated. The rates for excavation shall include excavation in any type of material or made up ground excluding rock as defined below. No claim will be allowed for lack of knowledge in this respect.

4.2.2 Levels

Immediately following the issue of the order to commence, the Contractor shall carry out and record a check level grid of the site which shall be agreed between the Architect and the Contractor within one week of the above order being given.

4.2.3 Setting out

Setting out shall be approved before work is commenced.

4.2.4 Clear Site

Generally, clear the site of all shrubs and trees, (i.e. not exceeding 600 mm girth), grub up roots and fill the holes with red earth. Trees and shrubs not directed for destruction to be made good at the Contractor's expense.

4.2.5 Excavation for Bases and Strip Foundation

Excavations for bases and strip foundations shall be to the widths, depth, and levels shown on the Architect's drawings. Rates shall be deemed to include for whatsoever alternative method the Contractor chooses to adopt.

4.2.6 Inspection of Excavations

The Architect shall be called to inspect the completed excavations before any permanent works can be commenced in them. The Contractor shall keep all excavations dry and free from rain or other surface water.

4.2.7 Excavations Below Required Levels

Excavations made below required levels shall be filled with Mass Concrete (1:4:8) at the Contractor's expense.

4.2.8 Disposal of Earth

Rates for filling of disposal of earth shall include for any double handling, except that resulting from a written order by the Architect to deposit earth in temporary spoil heaps pending its final disposal. Filling shall be in approved filling material to required levels in specified layers carefully rammed and consolidated. Disposal of all surplus excavated material shall be as instructed. Rates shall include for loading and wheeling off the site to a tip to be provided by the Contractor.

4.2.9 Hardcore

Hardcore shall be stone, coarse gravel or other inert material yielding, when thoroughly consolidated, a freely porous bed and blinded with fine hardcore, ashes and similar materials shall include for all temporary retaining boards and for rolling with an 8-10 tonne roller unless otherwise described, in layers not exceeding 150 mm deep.

4.2.10 Anti-Termite Treatment

Anti-Termite treatment for new works shall be fine sprayed using an approved insecticide.

4.2.11 Underground Public/Private Services and Structures

The Contractor shall at his own expense and before commencing excavations ascertain in writing from the utility companies, Local Authorities and other public bodies, companies and persons who may be affected, the position and depths of their respective ducts, cables, mains, or piles and appurtenances.

The Contractor shall there upon search and locate such services in order to appropriately prop, protect, underpin, alter, divert, restore and make good all

pipes, cables or ducts, poles or wires and their appurtenances disturbed or damaged during the progress of the works or consequent thereof.

Such services as required to be removed or altered by virtue of the situation of the permanent work and note the manner in which the work is carried out, shall be so removed or altered at the expenses of the Employer.

4.2.12 Rock Excavation

The term "Rock" shall mean any natural material which cannot be dislodged by a pick and which can only be removed by the use of compressors or by blasting or

wedging. This classification does not include materials that can be removed by means other than drilling and blasting or drilling and wedging, but which for reasons of economy in excavating, the Contractor prefers to remove by drilling and wedging. Unless specifically stated hereinafter, the Contractor must assume that permission to remove rock will be refused and he must therefore price for removing rock by compressors, etc. only.

4.2.13 Blasting

Blasting will only be allowed with the prior express permission of the Architect.

All blasting operations shall be carried out at the Contractor's sole risk and cost in accordance with any Government regulations in force for the time being, and any special regulations laid down by the Architect governing the use and storage of explosives.

4.2.14 White Ants' Nests

The Contract must destroy any termite nests found within the perimeter of the buildings and within a distance of 20 meters from the building externally and take out and destroy queens, impregnate holes and tunnels with approved insecticide and back-fill with hard material well rammed and consolidated. The rate will be deemed to include for this destruction and treatment.

4.3.0 MATERIALS

4.3.1 Blinding

Blinding shall be of the same material as the hardcore bed, crushed and graded from 4 mm upwards, free from clay, chemical or other pollutions, pests, weeds, roots and rubbish.

4.3.2 Hardcore

Hardcore shall be of good, clean, hard, broken stone, broken before placing to pass a 100 mm ring and free from all rubbish.

4.4.0 WORKMANSHIP

4.4.1 Generally

The Contractor shall control grading around the buildings so as to prevent water running into excavated areas or into completed sections of the work.

4.4.2 Bottoms of excavations to be approved

The Contractor shall give the Architect at least 48 hours' notice (this time shall be doubled if the site of the works is more than 100 km from the nearest permanent office of the Architect) when the excavations will be ready for inspection and agreement of the level thereof. If a good bearing bottom is not obtained at the level shown, the Architect is to be informed. No concrete is to be laid until the bottom has been approved and the level thereof taken. Any concrete work or other work done before such approval, shall, if so directed be removed and new work substituted after excavations have been approved, at the Contractor's expense. Notwithstanding such approval, any bottom which becomes waterlogged or otherwise spoilt after approval, shall be cleaned out and reformed to the Architect's approval before any concrete is placed. Before placing concrete or masonry on rock surfaces, the surfaces shall be leveled off or shelved to a slope not exceeding 25 mm per 300 mm.

4.4.3 Disposal of excavated material

Surplus excavated material where directed or required shall be removed from the site to a tip, the location of which shall first be approved by the Architect in writing. All fees and charges in connection shall be deemed to be included in the Contract Sum.

4.4.4 Timbering, planking, strutting, etc.

The Contractor shall provide all necessary timbering, planking and strutting, etc., to uphold the faces of excavation, which shall only be removed when it is safe to do so. Where the Architect instructs or agrees that it is necessary for the safety of the works to leave in timbering and, planking and strutting, etc., such timber shall be measured and agreed before covering up.

4.4.5 Filling

Return filling around foundations and filling to make up levels under floors and pavings shall not be deposited until the formation level has been approved by

the Architect. In no case shall fill be deposited on a muddy foundation. Filling shall be deposited in layers not exceeding 150 mm in depth before compaction and shall be compacted by rolling, pneumatic tamping or other approved means over the whole of the area.

If necessary the filling shall be allowed to dry or be moistened to the correct moisture content before compaction. The finished surface shall be approved by the Architect prior to further construction work thereon.

No excavation or foundation work shall be filled in or covered up until all measurements necessary for the adjustment or variations have been made.

4.4.6 Consolidation of hardcore

Hardcore shall be consolidated with a roller, vibrating roller, or mechanical punner to a compaction equivalent to that obtained with a 2.5 to 3 tonne roller, care being taken that no damage is done to the foundation walls.

Hardcore shall be blinded and have the interstices filled with blinding as described herein. Before placing concrete hardcore beds shall be well watered to prevent water absorption from the concrete.

Where described as blinded to receive any membrane, the blinding shall be finished and compacted with fine material which will not cause the membrane to puncture under wheel or foot traffic or by the placing of concrete.

4.4.7 Protection

The Contractor shall protect all graded and filled areas from the actions of the weather elements. Any settlement or washing away that occurs prior to acceptance of the works shall be repaired and grades re-established to the required elevations and slopes.

4.4.8 Laying polythene membrane

Where joints occur, there is to be a minimum of 300 mm welted lap or joint made with approved tapes.

The Contractor shall ensure that the membrane will not be pierced during laying and concreting.

4.4.9 Anti-termite treatment

Anti-termite treatment shall be carried out using 'Aldrex 48' or other equal and approved chemical by the Architect in writing diluted to a water emulsion containing a minimum of 0.5% of the chemical.

The treatment shall be applied to the whole area of the hardcore bed and tops of foundation walls immediately prior to the placing of the concrete floor

slab at the rate of 7 litres per square meter. The treatment at the same rate shall also be applied to all excavations for gum pole bases before any concrete is poured and around the outside of the base for a distance of 500 mm from the edge of the base excavation. To facilitate this, all excavated soil from the base is to be dumped more than 500 mm from the excavation.

Treatment shall not be applied whilst it is raining or to surfaces of filling which is wet.

For in-situ anti-termite treatment for existing works, drill 5/8 inch diameter holes 1 foot deep and not more than 2 feet between the holes and 3 inches from the inside faces of all the external perimeter walls of all rooms. Into each hole, inject under pressure approximately 5 litres of a suitable termicide such as Aldrex 48% E.C. or Pyrinex Professional Formula 42% E.C., as supplied by an approved supplier or other equal and approved supplier/manufacturer, at concentrations of 0.5% and 1% a.i. respectively. The holes are then sealed with the nearest matching material.

The Contractor's attention is drawn to the fact that these treatments are toxic to animals and human life an he shall prevent contamination of water supply systems, shall cover up and protect treated areas immediately after treatment and post written notices informing of the treatment at prominent points on the site and the building.

Immediately following treatment, the Contractor shall provide to the Architect for onward transmission to the Client, a written five year guarantee which guarantees:-

a) That the chemical used complies with this specification and has been used in the concentrations stated herein,

b) that the guarantee shall be continuous for a period of five years from the date of treatment,

c) that should infestation by any termites appear before the end of the five year period, the Contractor will return and re-treat as necessary to eliminate the infestation entirely and at his own cost on each occasion that infestation appears within the five year period.

The Contractor shall carry out annual inspections commencing three months after treatment and continuing to the end of the guarantee period to ascertain the presence of termites, and should any presence be found, the Contractor shall re-treat as necessary to eliminate any infestation entirely and at his own cost on each occasion that infestation is found.

5.0 CONCRETE WORK

5.0 CONCRETE WORK

5.1.0 STANDARDS AND CODES OF PRACTICE

The following authoritative standards are referred to hereinafter:

B.S	Date	Title
12	1989	Portland Cement (ordinary and rapid hardening)
812		Methods for sampling and testing of mineral aggregates, Sand and fillers.
882	1983	Aggregate from natural sources for concrete (including granolithics)
1881		Methods of testing concrete.
5328	1981	Methods for specifying concrete.
2499	1973	Hot applied joint sealants for concrete pavements.
3148	1980	Tests for water mixing concrete.
3921	1985	Clay Bricks.
4251	1974 (1980)	Truck type concrete
4449	1988	Carbon steel bars for the reinforcement of concrete.
4466	1981	Bending dimensions and scheduling of bars for the reinforcement of concrete (old edition)
4483	1985	Steel fabric for the reinforcement of concrete.
5075		Concrete Admixtures.
6073: Pt. 1	1981	Precast concrete blocks.
8110: Pt. 1 + 2	1985	The structural use of concrete
5950		The use of structural steel in buildings.
5400: Pt. 5	1979	Steel, concrete and composite bridges.
8807	1987	The structural use of concrete for retaining

aqueous liquids.

American Society for Testing and Material Standards as published by the American Society for Testing and Materials, 1916 Ract St., Philadelphia pa 19103 U.S.A. (Abbreviated in Test to AST).

ASTM	Date	Title
C88	73	Soundness of aggregates by use of Sodium Sulp
C234	71	Comparing concrete on the basis of the bond developed with reinforcing steel.
C289	71	Potential reactivity of aggregates (chemical me

The following codes of practice are referred to hereinafter:

British Standard Codes of Practice published by the Council for Codes of Practice British Institution, 2 Park Street, London WIA 2BS, England (abbreviated in text to C.P.)

C.P	Date	Title
CP. 117: pt. 1:	1965	Composite construction in structural steel and concrete.
B.S. 3110	1972	Safe use of cranes (mobile cranes, tower cranes and derrick cranes)

Should the contractor wish to substitute any of the authoritative standards or codes of practice for any listed above, he should submit details of any such standard or code together with two complete copies of the same to the Architect for approval with his tender. Approval will only be given to the use of such standard or code where the Architect considers the proposed standard or code of practice will give a quality of finished work equal to or better than the specified standard.

All in-situ concrete shall be in accordance with BS 8110 except where superceded by this specification.

All precast concrete shall be in accordance with BS 8110 except where superceded by this specification.

NOTE: The Contractor's attention is drawn to Section 'F' of the Standard Method of Measurements of Building Works.

5.2.0 GENERAL

5.2.1 Samples and Materials Generally

The Contractor shall, when required, provide for approval samples of all materials to be incorporated in the works. Such samples when approved shall be retained by the Architect and shall form the standard for all such materials incorporated. No deliveries to the site should commence before such approval is obtained.

No materials of any description will be used without prior sanction by the Architect and any condemned as unfit for use in the works must be removed immediately from site by and without recompense to the Contractor.

5.2.2 Test Certificates

The Contractor shall provide the Architect with three copies of all test reports or certificates that are or may be required by this Specification.

5.2.3 Suppliers

As soon as possible after the contract has been awarded and before finalizing any order for materials to be incorporated in the works, the contractor shall submit the names of any proposed suppliers to the Architect for approval.

Each supplier must be willing to admit the Architect, or his authorized representatives, to his premises during working hours for the purposes of obtaining samples of the materials in question.

The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no sources of supply will be changed without proper approval.

5.2.4 Drawings

The Contractor should check all drawings carefully before any part of the work is carried out. Any discrepancy should be reported to the Architect immediately for his clarification. The Contractor shall be responsible for any costs arising out of his failure to report such discrepancies to the Architect, in good time.
The Contractor shall ensure that he has all relevant drawings and bar bending schedules for any part of the works, well in advance of the executions of that part of the works. Any costs arising out of the Contractor's failure to ask for related drawings, or bending schedules in writing, in good time, shall be the responsibility of the

Contractor. The same shall hold true even if the contractor has submitted a programme of works at commencement.

5.2.5 Bending Schedules

The Architect will issue bar bending schedules in accordance with B.S. 4466 (1981). The Contractor should check these against the drawings before any cutting, bending or construction involving the schedules is started. Any discrepancy should be reported to the Architect immediately for his clarification. The Contractor shall be responsible for any delays or additional work caused solely by his failure to check the schedules.

5.2.6 Approval

Well before construction commences, the Contractor shall supply to the Architect for his approval, details of his proposed layouts of concreting plant and on site workshops, details of formwork systems and the construction devises, e.g. cranes, chutes, scaffolding, etc. which he proposes using for the structural work. The information is to be sufficiently detailed to enable the Architect to approve or otherwise.

The Contractor should note that further approvals are required by this specification before construction starts. The Contractor is wholly responsible for obtaining these approvals and no claim for delays will be entertained due to the Contractor's failure to obtain such approvals in adequate time.

5.2.7 Cement

In addition to the above Standards and Codes, cement shall comply with the following Kenya Standards:-

a)	Portland Cement	-	K.S. 02-21
b)	Rapid hardening cement	-	K.S. 02-21
c)	Sulphate resisting Portland Cement	-	B.S. 4027

Cement, unless so otherwise specified, shall be ordinary Portland cement complying with B.S. 12. Rapid hardening cement may be used in lieu of the ordinary Portland cement only with prior approval of the Architect, provided that all conditions applying to its use are strictly observed. Any additional expense in connection with the use of such cement shall be borne by the Contractor.

The use of high alumina cement will not be permitted.

5.2.8 Cement

The Contractor shall obtain a manufacturer's certificate of test in accordance with the appropriate standard for each consignment of cement delivered to the site and shall immediately forward copies of the same to the Architect for his retention.

Notwithstanding the manufacturer's certificate, the Architect may require that any cement delivered to the site be sampled and tested. Any batch of cement so tested which fails to comply with the specification will be rejected.

All cement, unless delivered in bulk shall be stored in a weatherproof shed, the floor of which shall be raised at least 150 mm above the ground to allow free air circulation. Cement delivered in bulk shall be stored in a weatherproof silo. All cement shall at all times be protected from deterioration.

All cement shall be delivered to the site in the original sealed bags of the manufacturer or in approved bulk containers.

Each consignment of cement shall be kept separate, identified and used in order of delivery. No two types of cement shall be used in combination.

Any cement upon inspection is considered by the Architect to have deteriorated in any way will be rejected.

5.2.9 Aggregate

In addition to the above Standards and Codes, aggregate shall comply with K.S. 02-95.

Any aggregate for concrete shall, unless otherwise specified, be aggregate from natural sources complying with B.S. 882. Additionally, the flakiness index when determined by the sieve method described in B.S. 812 shall not exceed 35 for any size of concrete aggregate. Fine aggregate within or finer than zone 4 of B.S. 882 shall not be used.

When tested for soundness in accordance with ASTM Test C8873 the loss of weight after 5 cycles shall not exceed 5% (percent) for any aggregate.

Aggregate which is potentially reactive when tested in accordance with ASTM Test C. 289-71 for the alkali aggregate reaction shall not be used. The Standard for acceptance being that test results shall plot to the let of the solid line which is shown in Figure 2 of the test standard.

Well before any concreting work, the Contractor shall forward to the Architect for approval, details of his proposed source of supply

of aggregate, giving the aggregate group classification and typical physical properties as required by B.S. 882.

The Contractor shall provide the Architect with a certificate for his retention showing that all aggregates regularly comply with the requirements for this specification.

The Architect may require that any aggregate be tested for soundness in accordance with ASTM Test C88-73 before giving approval to any proposed source of supply.

The Architect may require that any aggregate be tested for potential reactivity in accordance with
ASTM Test C.289-71.

Notwithstanding any certificate of compliance, the Architect may at any time require that any aggregate delivered to the site by sampled and tested. Any aggregate so tested which fails to comply with this specification will be rejected.
Coarse aggregate shall be delivered ready screened or screened on site into separate nominal single sizes within limits given in B.S. 882.

Aggregate of different sizes or types shall be stored in different hoppers or different stockpiles on approved well-drained paved areas which shall be separate from each other. Stockpiles shall be protected against contamination from any source.

Any aggregate which has become contaminated or which does not conform with the above requirements may be rejected by the Architect.

5.2.10 <u>Water</u>

Water for use in mixing with cement or for curing concrete shall be from an approved source, clean, fresh and free from organic and other deleterious matter.
The Architect may require that any water for the works be sampled and tested by the method given in the B.S. 3148 will be rejected.

Water for use in mixing with cement shall neither be hotter than 25° C (77 deg.F) - or colder than 5 deg. C (41 deg. F) at the time of mixing.

5.2.11 <u>Steel Rod Reinforcement</u>

Steel Rod Reinforcement shall consist of:-

a) Mild steel bars complying with B.S. 4449 and K.S. 02-22.

b) Hot rolled high yield bars complying with B.S. 4449

c) Cold worked high yield bars complying with B.S. 4449 as described in the drawings.

Where cold worked high yield bars are to be used, these shall be square twisted bars formed by a torsion controlled process.

The Contractor shall obtain manufacturer's certificate of test in accordance with the appropriate standard for each steel batch relating to reinforcement delivered to site and shall immediately forward copies of the same to the Architect for his retention.

Where hot rolled high yield deformed bars are to be used, the results of bond tests to
ASTM 234-71 using concrete of the same quality as that to be used in the works, shall be forwarded to the Architect.

Notwithstanding the manufacturer's certificate, the Architect may require that any reinforcement delivered to the site be sampled and tested. Any reinforcement so sampled and tested which fails to comply with this specification will be rejected.

All reinforcement shall be delivered to the site either as straight bars or ready cut and bent to shape.

All reinforcement shall be stored in clean conditions in an orderly manner to the satisfaction of the Architect such that the batch to which each piece belongs can be readily identified.

5.2.12 Steel Fabric Reinforcement

Steel fabric reinforcement shall be electrically cross welded steel mesh reinforcement complying with B.S. 4483.

5.2.13 Tying Wires

Tying wires for fixing reinforcement shall be either:

a) No. 16 gauge soft annealed iron wire; or

b) No. 18 gauge stainless steel wire.

5.2.14 Spacers

Spacer blocks required for ensuring that the reinforcement is correctly positioned shall be as small as possible consistent with their purpose, of a shape acceptable to the Architect, and designed so that they will not overturn when the concrete is placed. Unless otherwise approved, they shall be made of concrete with 10 mm maximum aggregate size and mix proportions to produce the

same strength as the adjacent concrete. S.W.G. 18 wire shall be cast in the block for the purpose of tying it to the reinforcement.

Spacer blocks of concrete shall not be used until at least 7 days old.

No admixtures or cement containing additives shall be used in concrete unless specified or approved by the Architect. Such approval will not be given unless in the Architect's opinion specific benefit to the density or quality of the concrete will result.

5.2.15 Wall Ties

Wall ties between concrete and adjoining block or brick walling shall be "Abbey" slots and anchors as supplied by Abbey Building Suppliers Limited or similar and approved. Wall ties must be provided at concrete and block or brick wall butting surface.

5.2.16 Joint Fillers

Joint Fillers, unless otherwise stated, shall be "Flexcell" as manufactured by Expandite Ltd. or similar and approved and placed in accordance with the manufacturer's instructions.

5.2.17 Joint Sealants

Shall be described in the drawings and approved by the Architect. Sealants shall be used strictly with the manufacturer's instructions.

Poured joint sealing compound shall be a hot poured rubber bitumen compound complying with the requirements of B.S. 2499.

5.2.18 Water Stops

Water stops, unless otherwise stated, shall be "Sika waterbar" as manufactured by Sika International or similar and approved and placed and jointed in accordance with the manufacturer's instructions. In addition, the method of holding the waterbar in position, while concreting, must be to the approval of the Architect.

5.3.0 REINFORCEMENT

5.3.1 Workmanship

Reinforcement shall be bent accurately in accordance with B.S. 4466 to the shape and dimensions shown in the schedules. All reinforcement shall be bent at temperatures in the range of 5° C and 100° C.

Cold worked or any high yield bars shall not be straightened or bent against once having been bent. When it is necessary to bend mild steel reinforcement already cast in the concrete, the internal radius of such bends shall be not less than twice the diameter of the bar.

No welding of reinforcement shall be carried out without the approval of the Architect.

All reinforcement shall be, at the time of concreting, free from mud, oil, mortar droppings, loose rust, paint, grease, mill scale or other deleterious matter. Reinforcement still 'blue' from the mill shall not be used.

All reinforcement shall be as where indicated on the drawings or as approved by the Architect. Unless otherwise indicated, the minimum lap length for rod reinforcement shall be 40 diameters for mild steel and 50 diameters for high tensile twisted bars.

A steel fixer shall be in attendance at all times when concreting is in progress to correct any errors, omissions or movement in the reinforcement.

In severe heat conditions, reinforcement shall be shaded from direct sunlight and hosed down with clean water prior to concreting to keep the reinforcement below 25° C. (77° F).

Notwithstanding any inspections and approvals regarding reinforcement, it shall be the Contractor's sole responsibility to ensure that the reinforcement complies exactly with the details on the Drawings or Schedules or other written instructions by the Architect.

5.3.2 Composite Floor Slabs

Concrete hollow pots for use in the composite floor slabs are to be of the sizes required as shown on the drawings and with 25 mm wall thickness and are to be true to shape, free from cracks or distortion, of adequate strength to support the concrete during placing and consolidation by vibration. Stocks are to be manufactured in accordance with the procedure specified in B.S. 2028 and to be of mix not weaker than 1:4:8 cement, sand, stone, using maximum 10 mm size aggregate. Samples must be approved before incorporation into the works.

Concrete hollow pots are to be cured for at least 28 days before use on site. During the first seven days of curing, pots are to be kept permanently damp and protected from exposure to sun and wind.

Hollow clay pots where indicated for use in the composite floor slabs are to be the sizes shown on the drawings and to be of adequate strength to support the concrete during placing and consolidation by vibration. They shall be obtained from an approved manufacturer. Before any orders are placed, at least 6 samples clay blocks shall be provided for the approval of the Architect. Any clay blocks subsequently delivered to site which in the opinion of the Architect are not of equal standard to the approved samples shall be rejected.

Rejected pots shall immediately be removed from site and shall not be used in the works. Clay blocks are to be fully cured before delivery or use on site.

Defective or damaged pots are to be removed immediately from site.

The hollow pot floor construction is generally to be as shown on the Architect's drawings.

Care shall be taken in planning pots to ensure that they are set out in accordance with the details shown on the Drawings and they run truly in line without encroaching on the width of the in-situ ribs.

The open ends of hollow pots, if adjacent to concrete to be placed in-situ, are to be plugged or stopped to prevent the concrete from flowing in the void and the Contractor is to include for this in his rates.

The Contractor should note that slip tiles are not to be used to the soffite of ribs and he is to take this into consideration in pricing the items of formwork to the soffite of hollow pot floor construction.

Before concreting is carried out, the pots are to be thoroughly wetted.

Care should be taken during concreting that the width of ribs between the rows of pots and the solid in-situ concrete shown on the Drawings adjacent to stopping beams is not encroached upon by the pots.

Where holes for service occur, the necessary holes or pockets shall be accommodated by replacing of a hollow pot by in-situ concrete or the widening of a rib.

Prices for such holes through hollow pots slab construction are to include for the re-arrangement or substitution of the hollow pot with solid concrete or the widening of a rib.

The concrete topping shall be poured at the same time as the ribs between hollow pots.

Reinforcement shall be positioned accurately with the specified cover in accordance with the Drawings and using the particular spacer blocks as previously described.

Spacer blocks shall be provided at no more than 1.2 m centers.

Care must be taken during concreting that the reinforcement is not displaced.

5.3.4 Composite Construction of Beams and Columns

The Contractor shall provide a method statement for construction of concrete encased steel columns and beams. Notwithstanding the

Architect's approval of this method statement, the responsibility of producing workmanship of the specified quality shall rest entirely with the Contractor. In addition the Contractor shall construct a sample of a concrete encased column and beam on site in accordance with the method statement for approval. If approved, all composite construction for the works shall be of a similar quality. The Contractor should allow for hoisting of steel beams and columns in his rates.

The Contractor shall maintain, on site for the duration of the contract, all equipment required for modifications to 'in-position' steel beams and columns.

The Contractor is to note that steel grade 43, shall be used in composite beams and steel grade 50 will be used in composite columns.

All connections of steel beams to columns and column splice connection details shall be as specified on the structural drawings.

5.4.0 FORMWORK

5.4.1 Definition

"Forms, falsework or shuttering" shall include all temporary moulds forming the concrete to the required shape together with any special lining that may be required to produce the concrete finish specified.

All timber for formwork, falsework and centering shall be sound wood, well seasoned and free from loose knots, shakes, large cracks, warping and other defects. Before use on the work, it shall be properly stacked and protected from injury from any source. Any timber which becomes badly warped or cracked, prior to the placing of concrete, shall be rejected.

If the Contractor proposes to use steel shuttering, he shall submit to the Architect, dimensioned drawings of all the component parts, and give details of the manner in which he proposes to assemble or use them. Steel shuttering will only be permitted if it is sturdy in construction and if the manner of its use is approved by the Architect.

Struts and props shall, where required by the Architect, be fitted with double hardwood wedges or other approved devices so that the moulds may be adjusted and eased gradually when required. Wedges shall be spiked into position and any adjusting devices locked before the concrete is cast.

All forms shall be wood or metal and shall be built grout-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations.

Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the timber.
All formwork shall be approved by the Architect before concrete is placed within it. The Contractor shall, if required by the Architect, provide the latter with copies of calculations of strength and stability of the formwork or false work but notwithstanding the Architect's approval of these calculations, nothing shall relieve the Contractor of his responsibilities for the safety or adequacy of the formwork.

5.4.2 False work and centering

Detailed plans for false work or centering shall be supplied by the Contractor to the Architect at least 14 days in advance of the time the Contractor begins construction of the false work. Notwithstanding the approval of the Architect of any designs of false work submitted by the Contractor, the Contractor shall solely be responsible for the safety and adequacy of the false work or centering.

All false work shall be constructed to provide the necessary rigidity and to support the loads from the weight of green concrete and shutting and incidental construction loads.

False work or centering shall be founded upon a solid footing safe against undermining and protected from softening. False work which cannot be founded on satisfactory footings shall be supported on piling which shall be spaced, driven and removed in a manner approved by the Architect. The Architect may require the Contractor to employ screw jacks, or hardwood wedges to take up any settlement in the formwork either before or during the placing of concrete.

False work shall be set to give the finished structure the required grade and camber shown on the drawings.

5.4.3 Form of Construction Joints

Where permanent or temporary joints are to be made in horizontal or inclined members, stout stopping off boards shall be securely fixed across the mould to form a grouting joint. The form of the permanent construction joints shall be as shown on the drawings.

Where reinforcement or water stops pass through the face of construction joints, the stopping off boards shall be drilled so that the bars or water stops can pass through or the board shall be made in sections with a half round indentation in the joint faces for each bar so that when placed, the board is a neat and accurate

fit and not grout leaks from the concrete through the bar holes, joints or around the water stops.

The forms shall be restrained and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

All sharp edges inside the forms shall be provided with 25 mm by 25 mm triangular fillets, unless otherwise shown on the drawings or directed by the Architect.

Openings for the inspection and cleaning of the inside of shuttering for walls, piers and columns shall be formed in such a way that they can be closed conveniently before commencing to concrete.

When concrete is to be deposited to a steeper slope than 15° to the horizontal, top forms shall be used to enable the concrete to be properly compacted.

Form, clamps, tie bolts an anchors shall be used to fasten forms. The use of wire ties to hold forms in position during placing of concrete will not be permitted. Tie bolts and clamps shall be positive in action and of sufficient strength and number to prevent spreading or springing of the forms. They shall be of such type that no metal part shall be left within the specified concrete.

The cavities shall be filled shall be filled with grout or mortar and the surface left sound, smooth, even and uniform in color. All forms for outside surfaces shall be constructed with stiff walls at right angles to the studs and all form clamps shall extend through and fasten such walls.

The shapes, strength, rigidity, water tightness and surface smoothness of re-used forms shall be maintained all times. Any warped or bulged timber must be replaced. Forms which are unsatisfactory in any respect shall not be re-used.

All forms shall be treated with approved mould or similar oil or be soaked with water immediately before placing concrete to prevent adherence of concrete. Any materials which adhere to or discolour concrete shall not be used.

All forms shall be set and maintained true to the line designed until the concrete is sufficiently hardened. Forms shall remain in place or a period which shall be as specified hereinafter. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Architect shall order the work stopped until the defects have been corrected.

5.4.4 Release Agents

Only approved chemical release agents, mould creams (emulsions of water in oil) or oil containing a proportion of surfactant not exceeding 2% will be permitted. Water soluble emulsion and oils without surfactant shall not be used. Oil based release agents shall be applied at a ratio of 7m2/litre 24 hours in advance of concreting, preferably by spray or roller. Chemical release agents shall be applied in accordance with the manufacturer's recommendations.

The greatest care must be taken that all sawdust shavings, chips and other debris is removed from the formwork before concrete is placed in position and the necessary arrangements must be made by leaving out aboard in the bottom of the formwork or otherwise as required.

The erection, easing, striking and removal of all formwork must be done under the personal supervision of a competent foreman, and any damage occurring through faulty formwork or its incorrect removal shall be made good by the Contractor at his own expense.

All projecting fins on the concrete surfaces after removal of formwork shall be chipped off, and any voids or honeycombing to any surface made good to the requirements of the Architect.

No patching of the concrete is to be done before inspection of the concrete surfaces as stripped.

Traffic or loading must not be allowed on the concrete until the concrete is sufficiently matured and in no case shall traffic or loading be of such magnitude as to cause deflection or other movement in the formwork or damage to the concrete members. Where directed by the Architect, props may be required to be left in position under slabs and other members for greater periods than those specified hereinafter.

5.4.5 Striking Times

It shall be the Contractor's responsibility that no distortion, damage, overloading or undue deflection is caused to the structure by the striking of formwork, but the Architect reserves the right to delay the time of striking in the interest of the work. Formwork shall not be struck until the concrete has sufficiently hardened. Approval of the Architect shall not relieve the Contractor of his liability to make good any concrete damaged by premature removal or collapse of forms. In no circumstances shall forms be struck until the concrete reaches a cube strength of at least twice the stress to which the concrete may be subjected at the time of striking.

The following times given in a day (24 hours) are the absolute minimum that will be permitted:-

Forms	Ordinary Portland Cement	Rapid Hardening Cement
Walls, columns (unloaded), Beams sides	2	2
Slabs - props left under	7	2
Beams soffites - props left under	14	5
Slabs - props	14	5
Beams - props	18	8

The time for removal of forms as set out shall not apply to slabs and beams spanning more than 10 meters. For such spans appropriate times shall be recommended or advised by the Architect.

The periods given above are based on the removal of all props and formwork using ordinary Portland cement under average weather conditions. Adverse weather conditions or different cement may cause the above period to be increased. Should the Contractor wish to make use of reduced striking time, then he must satisfy the Architect that the strength of the concrete at such time and the structural system is adequate to withstand the dead and imposed loads applied to it. Before making use of reduced striking times the Architect's agreement must be obtained in writing.

Where the structure is of multi-storey construction, props with head trees and braces shall be provided to distribute the imposed load below the floor being cast. This will normally be 3 -storey heights below the floor being cast unless otherwise stated.

5.5.0 FINISH TO CONCRETE SHUTTERED SURFACES

5.5.1 Sawn Finish

The shuttering shall consist of saw boards, sheet metal or other suitable material to give a support to the concrete. Appearance is not of primary importance for this class of formwork. It shall be used for surfaces against which backfill or further concrete is to be placed. The treatment of the shuttering or concrete to provide a board for the further surface treatment of the concrete shall be directed or approved by the Architect. Masonry or similar material used for facing concrete shall only be used as shuttering where directed by the Architect.

The Architect's approval shall be obtained to the use of blocks or slabs when used as permanent forms in foundations and other similar locations.

5.5.2 Wrought Finish

The shuttering shall be wrought with boards arranged in a uniform pattern. Alternatively, plywood, metal panels, or other approved materials may be used, subject to the Architect's approval. Joints between boards or panels shall be horizontal or vertical unless otherwise directed. This shuttering shall give a good finish to the concrete and will normally be used for all faces where a high class finish is not necessary.

5.5.3 Fair-faced Finishing

Standard steel panels, hardwood and boarding will not be permitted for the face of this shuttering. The shuttering shall be faced with resin-bonded plywood, faced with matt finished plastic or equivalent material in large sheets which shall be arranged in an approved uniform pattern. Wherever possible, joints between sheets shall be arranged to coincide with features such as sills, heads, jambs or changes in direction or the surface areas of formwork between features in walls, between beams in horizontal surfaces or other or similar arrangement, shall where possible be divided into panels of uniform dimensions, without the use of make-up pieces. All joints between panels or vertical or inclined surfaces shall be vertical or horizontal unless otherwise directed by the Architect; those on horizontal surfaces shall be at right angles and wherever possible they shall be parallel to walls and beams. The shuttering shall give a high class finish to the concrete with no lips, fins, or irregularities, and shall give a completely true and even surface which will be prominently exposed to view where good alignment is of special importance. It is for use in both in-situ and precast concrete.

5.5.4 Textured Finish

This is an all-over finish of high quality as may be directed by the Architect. Sample panels may be constructed on site prior to commencement of the works, to compare different textures. The shuttering shall be such that the concrete finish has no lips, fins or irregularities and shall give a surface, which will be prominently exposed to view where good appearance and alignment are of special importance.

5.5.5 Chisel Dressed Finish

This finish consists of cutting a maximum of 10 mm of concrete surfaces to expose the aggregate. This work is to be carried out

after the concrete is at least 30 days old and is to be executed by hand. Mechanical means will not be permitted.

5.5.6 Other Finishes

Where other finishes, apart from the above are specified, the Contractor provide a sample panel at least 2.4 m x 1.2 m in vertical surface area including a typical horizontal and vertical joint in the shuttering. The sample panel shall be constructed using the systems of shuttering and the construction techniques that the Contractor proposes for the actual works. This sample when approved will form the standard for the entire works. All unsuccessful samples shall be removed from the site.

5.5.7 Floor Finishes

"Tamped Finish"

Where "tamped finish" is specified, it will be obtained by an edge board to the Architect's approval. Board works are to be made to a true pattern and will generally be at right angles to the traffic flow. Haphazard or diagonal tamping will not be accepted.

5.6.0 CONCRETE MIXES, GENERALLY

5.6.1 Work Cubes

For all structural concrete, the following representative sample shall be taken and in accordance with B.S. 1881:-

One each day on which less than 50 cu.m. of concrete is being poured.

a) Six 150 mm cubes - three for test 7 days and three for test 28 days; and
b) Two slump tests; or
c) Two compacting factor tests

On any day when greater quantities of concrete are being poured then six additional cube tests and two additional slump or compacting factor tests shall be carried out for each 50 cu.m. or part thereof.

All cubes shall be marked with the date of casting and a reference number. For each cube a record shall be kept of the position in which the batch of concrete from which it was sampled was placed. All cubes shall be tested by an approved testing authority.

The concrete cubes tested at 7 days are intended to be indicative only and the target works strengths at 7 days given in Table I or II are not mandatory. It should be noted however that it is unlikely that cubes failing the 7 days target will subsequently pass the 28 days cube strength.

The concrete cubes tested at 28 days shall be taken to represent the concrete placed in the works. The standard of acceptance for cube strength tests shall be as follows:-

The cube strength shall be calculated from the maximum load sustained by the cube failure. One test result shall be the average of two test specimens taken from the same sample. The appropriate strength requirement, as given in Table I or II shall be considered to be satisfactory if:

a) None of the strengths of the three cubes is below the specified cube strength, of if,

b) The average strength of three cubes is not less than the specified cube strength and the difference between the greatest and the least strengths is not more than 20% (percent) of that average.

The standard of acceptance of the slump test during the production of concrete shall be the design slump +/- 25 mm.

The standard of acceptance for the compacting factor test during the production of concrete shall be design compactor factor +/ 0.03.

Any concrete which fails to meet the above standard of acceptance shall be either further tested or condemned at the Architect's sole discretion. Any such tests or the removal of condemned concrete, replacement and associated costs shall be at the Contractor's expense.

If the strengths required are not attained or maintained throughout the contract, the Contractor will also be required to redesign the mix and submit trial mixes in accordance with the specification so as to give a concrete which does comply with the requirements of this specification.

5.6.2 Concrete Mixes, Nominal Mixes

Mixes for each class of concrete specified or shown on the drawings shall be used by the Contractor. They shall be mixed to achieve high density combined with adequate workability for the purpose.

Details of any proposed mix shall be forwarded to the Architect not less than 7 days before that class of concrete is required to be used on the works for his approval in principle.

Classes of concrete will be referred to by their nominal mix proportions. Classes of concrete shall meet the criteria shown in Table I.

The workability of the concrete shall be the minimum consistent with producing a dense, well compacted mass. Due regard shall be paid to the size and shape of the section together with any congestion of reinforcement..

5.6.3 Concrete Mixes, Design Mixes

Mixes for each class of concrete specified or shown on the drawings shall be designed by the Contractor to achieve the specified minimum cube strength combined with high density and adequate workability for the purpose.

In order to allow for unavoidable variation, the mean design strength should exceed the specified works cube strength by twice the expected standard deviation. In the absence of previous information, a standard deviation of 7N/MM2 should be assumed.

Details of any proposed mix design shall be forwarded to the Architect not less than 7 days before that class of concrete is required to be used on the works for his approval in principle. The details shall include at least the following information:-

a) Source, nature and grading of course and fine aggregates.
b) Source of cement.
c) Nominal maximum size of aggregate.
d) Cement content
e) Aggregate/cement ratio
f) Water/cement ratio
g) Design density
h) Design slump or compacting factor
i) Design strength

Classes of concrete will be referred to by the minimum 28 days work strength and the maximum size of aggregate. Classes of concrete shall meet the criteria shown on Table II.

The maximum water/cement ratio is herein defined as the ratio of the weight of the "free" water available to the weight of the cement. The "free water" is that quantity of water available to combine with the cement. Any required to be absorbed by aggregate is excluded.

The workability of the concrete shall be the minimum consistent with producing a dense well compacted mass. Due regard shall be paid to the size and shape of the section together with any congestion of reinforcement.

After the Architect has approved a design mix in principle, the Contractor shall prepare a trial mix on site using plant and materials intended for the works. Three batches of concrete shall be sampled and the following prepared, from each batch in accordance with B.S. 1881:

a) Nine 150 mm cubes, three for test at 7 days, three for test at 14 days and three for test at 28 days; and

b) Three slump tests, or where the design slump is less than 25 mm; and

c) Three compacting factor tests.

The standard of acceptance of preliminary tests will be similar to the standard for normal cubes, slump or compacting factor, except that the minimum cube strengths required shall be those given under "minimum preliminary cube strength at 28 days" in Table I and II.

No structural concrete shall be placed in the works until the Architect has approved preliminary tests. Thereafter the approved mix proportions shall be adhered to, throughout the work and may only be varied with the prior approval of the Architect.

(Concrete Mixes (Generally) (ctd)

TABLE 1: PRESCRIBED WORKMANSHIP CONCRETE MIXES

Class of Concrete	Minimum work Cube strength Of 28 days N/MM2	Cement Kg.	Fine Aggregate Cubic Metres	Coarse Aggregate Cubic Metres	Minimum Preliminary Cube Strengthen at 28 days N/MM2	Minimum Target Works Cube strength at 7 days N/MM2
1:1:2	30	50	0.035	0.07	40	22
1:1:5:3	25	50	0.05	0.10	40	19
1:2:4	20	50	0.07	0.14	28	14

TABLE 1: PRESCRIBED WORKMANSHIP CONCRETE MIXES

Class of Concrete	Minimum work Cube strength Of 28 days N/MM2	Maximum size of Aggregate MM	Minimum Cement Content KG/M3	Maximum Water Cement Ratio	Maximum Cement Content KG/M3	Minimum Preliminary Cube Strength at 28 days	Minimum Target Works Cube Strength at 7 days N/NN2
40	40	20	350	0.44	540	40	30
30/40	30	40	300	0.46	540	40	22
30/20	30	20	310	0.46	540	40	22
30/10	30	10	340	0.46	540	40	22
25/40	25	40	280	0.53	540	33	19
25/20	25	20	295	0.53	540	33	19
25/10	25	10	325	0.53	540	33	19
20/40	20	40	260	0.60	540	28	14
20/20	20	20	280	0.60	540	28	14

5.6.4 Tolerance

All in-situ concrete shall be dimensionally accurate to within the following non-accumulative tolerances:-

a) Between the centre lines of principal member columns or beams ……+/- 5mm

b) Up to 5 metre centres ……+/- 5mm

c) Over 15 metre centres …… +/- 5mm
(Note:- The +/- 5mm is floor to floor).

d) In storey height ……..+/- 5mm floor to floor.

e) In plumpness of columns and walls …+/- 10 mm on any storey or overall the structure.

f) In level of floors ……..+/- 5 mm/ - 3 mm of the true prescribed horizontal surface level.

g) In cross sectional dimensions of column, beams and walls …….. +/- 5 mm/ - 3 mm

h) In any dimensions up to 2 metres overall +/- 10 mm/ - 3 mm

i) Cover to reinforcement…… + 5 mm/ - 0 of the stated covers.

5.6.5 Miscellaneous Items

Holes, chases, indentations and the like shall be provided where indicated on the drawings. All such shall be formed in the concrete and not cut after concrete has hardened.

Should the Contractor or any Sub-contractor require additional holes of the like, these requirements shall be submitted to the Architect at least two days prior to concreting, for his approval.

Pipes, conduits, fixing bolts and other such cast-in items shall be provided where indicated on the drawings.

Should the Contractor or any Sub- contractor require additional cast-in items, these requirements shall be submitted to the Architect at least two days prior to concreting, for this approval.

5.6.6 Ready Mixed Concrete

Ready Mixed Concrete shall be used only with the approval of the Architect. When such approval is given, it shall be supplied

in accordance with B.S. 5328, except where this conflicts with this specification, wherein this specification shall prevail.

Truck mixer units and their mixing and discharge performance shall comply with the requirement of B.S. 4251.

The use of ready mixed concrete shall not relieve the Contractor of any of his obligations, and the appropriate clauses of this specification shall apply equally to the ready mixed concrete.

Concrete test cubes and slump tests shall be taken on site at the point and time of discharge in accordance with this specification irrespective of any cubes that the supplier may take at his own risk.

5.7.0 MIXING AND TRANSPORTING CONCRETE

All materials for concrete shall be measured by weight in approved weight batching equipment. Such equipment shall be checked at weekly intervals at the Contractor's expense and shall be accurate to within 2%. Certificates of accuracy shall be submitted immediately to the Architect.

a) All concrete shall be mixed in approved power driven mixers of a type and capacity suitable for the work. The mixer shall be equipped with an accurate water measuring device which shall be checked at weekly intervals at the Contractor's expense. Certificates of accuracy shall be submitted immediately to the Architect.

All materials shall be thoroughly mixed dry before water is added and the mixing of each batch shall continue for a period of not less than two minutes after the water is added or such longer periods as recommended by the manufacturer of the mixer. The mixture shall be of uniform colour and distribution on discharge and the entire contents of the mixer shall be discharged before recharging. The volume of mixed material shall not exceed the rated capacity of the mixer.

The Mixer shall at all times be kept in a clean condition. Prior to the first mix each day being agitated in the mixer, a rich cement:sand mix shall be used to coat the inside of the drum, the surplus material being emptied away and not used in the works.

The moisture contents of the coarse and fine aggregate shall be checked by the Contractor at frequent intervals and the amount of water added to the mix adjusted to maintain the design workability.

Concrete shall be discharged from the mixer onto a clean, level, watertight platform or into a clean watertight container. It shall be transported in a manner which ensures that it is of the correct quality and consistency at the point of deposition. All platforms and containers shall be cleaned of the old concrete before the fresh concrete is discharged onto them.

Concrete shall not be dropped from a height, thrown or otherwise treated so that segregation, undesirable finish or defective structural quality results. In any case concrete shall not be dropped from a height greater than 3.0 m.

No extra water shall be added to the concrete mix after it has left the mixer.

The Contractor shall take adequate precautions to protect concrete in transit from the effects of the weather.

Pumping of concrete, which will require a special design mix, will only be permitted with the approval of the Architect.

Should the concreting be stopped due to mechanical malfunction, accident or other similar cause, then the Contractor shall inform the Architect immediately so that necessary measures and precautions can be taken. The cost of any additional work caused by these stoppages shall be the responsibility of the Contractor.

No concreting shall be commenced until the formwork and reinforcement have been inspected by the Architect. The Contractor shall give the Architect two clear days' notice of his intention to concrete.

5.8.0 PLACING AND COMPACTING CONCRETE

All concrete shall be vibrated unless otherwise specified. The vibration shall be carried out by experienced operators and with immersion type vibrations to the Architect's satisfaction.

Placing of concrete shall be carried out in layers not exceeding 500 mm deep and in sequence from one end of the form to the other.

Concrete in foundations and other underground work shall be protected from contamination with falling earth or rock during and after placing.

Any concrete which shows signs of initial setting before or during placing shall not be used and it shall be removed at the Contractor's expense.

Sufficient vibrators shall be provided to correspond with the rate of deposition of concrete. The vibrators shall be continuous throughout the placing of the concrete. Standby vibrators shall be on site during all concrete placing.

Vibration must not be allowed to disturb any recently placed concrete that has begun to set. Any water accumulating on the surface of newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed.

Suitable means shall be provided to ensure that the temperature of the concrete on placing does not exceed 30 deg.C (86 deg.F). All surfaces shall be thoroughly dampened immediately prior to placing fresh concrete to prevent excessive absorption of water.

5.9.0 UNIFORMED FINISHES FOR CONCRETE

Where concrete surface is specified as suitable for receiving a further applied finish or in all cases where no other finish is specified, the concrete shall be uniformly leveled and screeded to produce a rigid surface. No further work shall be applied to the surface.

Where a concrete surface is specified as exposed with no further applied finish, the concrete shall be uniformly leveled screeded to produce a plain surface. After the concrete has hardened sufficiently, the surface shall be hand or machine floated sufficiently only to produce a uniform surface free from screed marks.

5.10.0 CONSTRUCTION, CONTRACTION AND EXPANSION JOINTS

Construction joints will be permitted only at the positions shown on the drawings and as instructed on the site by the Architect. These joints will in general be spaced to allow a maximum plan area for any bay of 100 sq.m. and maximum length of 12 m in any one dimension.

Vertical construction joints shall be properly made to form a vertical grout tight joint. Where reinforcement passes through the face of the joint, the stopping off board shall be drilled so that the bars pass through or the board shall be made in sections with half round indentation in the joint.

Under no circumstances shall concrete, when being deposited, be allowed to 'tail off'. Construction joints formed with expanded metal or similar will not be permitted for reinforced concrete work.

At all construction joints, both horizontal and vertical the surface of the already placed concrete shall be suitably roughened to remove latency and by exposing the coarse aggregate to form a key for adjacent concrete. This work shall be carried out to the satisfaction of the Architect by the following or other approved methods:-

a) After the initial set has taken place but before final set, the coarse aggregate shall be exposed by the use of a water jet brushing.

b) After final set has taken place, the latency shall be removed and coarse aggregate shall be exposed by brush hammering or chiseling.

In both cases the surface is to be thoroughly cleaned after roughening.

At least 72 hours shall elapse between completion of concreting one bay and the start of concreting any adjacent bay if the Architect deems fit.

Construction joints shall be formed as detailed where shown on the drawings.

Expansion joints shall be formed as detailed at the position on the drawings.

5.11.0 CURING AND PROTECTING CONCRETE

Immediately after compacting and for 7 days thereafter, concrete shall be protected against harmful effects of the weather including rain, rapid temperature changes and from drying out. The methods of protection used shall be subject to the approval of the Architect. The method of curing used shall prevent loss of moisture from the concrete.

During the curing period, horizontal surfaces shall be protected by the following or other approved means:-

a) Covering with damp hessian canvas sacks or similar absorbent materials kept constantly damp and wholly covering the exposed concrete surface or

b) Covering with an impermeable material raised approximately 50 mm over the surface so as to prevent loss of moisture.

c) An approved membrane curing compound.

During the curing period, other surfaces shall be protected by the following or other approved means:-

a) Formwork in close application of water, preferably in the form of a mist so as not to damage the surface.

b) Direct and continuous application of water, preferably in the form of a mist so as not to damage the surface.

All concrete faces or edges, particularly those which are exposed without rendering in the final structure, shall be adequately protected from damage and discolouration at all times.

Concrete structures shall NOT be loaded until the concrete is at least 21 days old or 28 days in the case of cantilevers. With the prior approval of the Architect the structure may be loaded before this time but in no case will loading be greater than the final design loading be permitted.

5.12.0 TEST FOR DEFECTIVE CONCRETE

Additional tests may be necessary when there are physical defects in the finished concrete. These defects may be in the form of cracking while the member is still under props, excessive deflection or segregation and insufficient strength of concrete test cubes. If in the opinion of the Architect these defects are as a result of the Contractor's bad workmanship, then the contractor will be required to carry out additional tests which the Architect may deem necessary to establish the load carrying capacity of the member. All costs for the test or incurred thereof as a consequence of the test shall be

chargeable to the Contractor. Costs for tests shall be borne by the Contractor immaterial of the outcome of such tests.

5.13.0 CONCRETE FOR WATER RETAINING STRUCTURES

Concrete, and its constituents for water retaining structures, in addition to the general and particular provisions in this specification, shall comply with the following requirements in this section:-

In addition to the requirement of the following clauses, concrete in water retaining structures shall have a low dying shrinkage and absorption, as measured in accordance with B.S. 812 or not greater than 3%.

The Architect may, before approval is given to an aggregate or at any time thereafter require, that the aggregate be tested for absorption in accordance with B.S. 812. Any aggregate failing to comply with this specification will be rejected.

In addition to the requirements of this specification, concrete for the water retaining structures shall have maximum cement content of 400 kg/M^3.

Blinding concrete under water retaining structures shall be a minimum of 75 mm thick and shall be in class 15/40 concrete.

Class15/40 concrete shall comply with the following requirements:-

a) Minimum works cube strength at 28 days …….. 15/N/mm2

b) Maximum size of aggregate …….. 40 mm

c) Mix proportions …….. 1 cement : 2.5 fine aggregate
: 5 coarse aggregate

This is nominal mix and no cubes will be required to be taken.

The construction joints will, in general be spaced to allow a maximum plan area for any bay of
40 sq.m. or maximum lengths of 7.5 m in any one dimension.

A waterproofing additive - "plastocrete DM" by Sika or other similar and approved shall be used for all reinforced concrete in water tank structures.

All additives shall be incorporated into the mix according to the manufacturer's instructions.

At least 96 hours shall be left between completion of concreting any adjacent bay if the Architect deems fit.

A kicker of minimum height 150 mm shall be cast integrally with the base slab for all water retaining structures.

The surface of all concrete for water retaining structures shall not be permitted to dry out even after the 7 day curing period specified in this specification.

All pipes passing through concrete walls or slabs for water retaining structures shall be cast in at the time of concreting and not subsequently fitted. All such pipes shall be provided with puddle flanges fitted to form a seal against the pipe and of an outside diameter of 2.00 m greater than the outside diameter of the pipes.

Joint sealants shall be applied not less than 7 days after completion of the structure.

On completion of water retaining structures at a time decided by the Architect, it shall be tested for water tightness in the following manner:-

a) Structures which are elevated shall be filled at a uniform rate not exceeding 1 meter rise in head per 24 hours and allowed to absorb water for 3 days. After this period the water level shall be brought up to the top water level and left for 7 days. During this period the exposed faces shall show no signs of leakage and shall remain apparently dry.

b) Structures founded on or in the ground shall be tested prior to backfilling unless otherwise stated. The structure shall be filled as specified above. After filling to top water level, no structure will be deemed to be watertight if at the expiration of this time the total 100 mm after making due allowance for evaporation and absorption and no signs of leakage are observed.

Water for testing shall be provided at the Contractor's expense.

If the structure fails the test above, any defects shall be made good or such action taken to eliminate leakages, as the Architect shall direct. All such work shall be at the Contractor's expense.

After completion of any repairs, the structure shall be tested using the procedure specified above.

Swimming pools should be tested prior to applying internal finishes.

5.14.0 PRECAST CONCRETE

The materials for precast work shall be similar to the materials for in-situ work. The workmanship for precast work shall comply with C.P. 116 except where this conflicts with this specification when the specification shall prevail.

The Contractor shall prepare for any type of precast units, a drawing indicating his proposed formwork construction, casing method, de-moulding and handling procedure for the Architect's approval.

Moulds and formwork shall be so constructed that the dimensions of the finished concrete members are within the specified permissible tolerances given in Clause 407 of B.S. 8110.

Where precast concrete is described as "Fair Faced", the moulds shall be metal, or are to have metal or hard board linings, or are to be other approved moulds which will produce a smooth, dense fair face to the finished concrete and free from all shutter marks, holes, pitting, etc.

Precast concrete shall be of the mixes described on the drawings in suitable mould, true in form of the shapes require, thoroughly tamped into the moulds and around reinforcement and vibrated.

All precast concrete work shall be carried out under cover and the period before removal from forms and the period of storing shall be determined and agreed by the Architect and the Contractor with due regard to the type of unit, i.e. load bearing or non-load bearing, difficulties of casing, projections, holes and other points which require particular attention.

The method of lifting, position of lifting points and curing time before lifting shall be agreed with the Architect before casting of any units.

Extreme care shall be taken when handling precast units and any units damaged during transportation and/or positioning shall be replaced at the Contractor's expense.

5.15.0 MEASUREMENT PREAMBLES

Concrete work shall be measured generally in accordance with the method of measurement stated in the contract. The rates shall be deemed to include for complying with the specification in all respects. All testing and samples required by the specification, whether covered by a particular item below or not, shall be deemed to be included within the rates or sums in the Bills of Quantities. Where the Architect may instruct the Contractor to test (such test not being mandatory), the materials or workmanship in accordance with the provisions of the specifications, the test of such costs will be borne by the Employer, if the test result proves unsatisfactory. In either case no consequential costs or delay will be allowed, it being considered that testing covered by this specification is being of a usual or expected nature.
The rate for concrete shall include for all costs associated with the following:-

a) Supply concrete of the required strength, manufactured with materials complying with the specification.

b) Mixing, transporting, placing, compacting, curing and protecting the concrete all as specified.

c) Forming construction joints and complying with the specified requirements for maximum bay size and intervals between casting adjacent bays.

d) Providing test certificates for cement and aggregates.

e) Designing the concrete mix (where applicable) and carrying out trial mixes and preliminary tests.

f) Carrying out routine sampling and testing of concrete and its constituents.

5.15.1 Mass concrete

The rate for mass concrete in blinding shall, in addition to B. (a) to B. (f) above, include, for concreting the sub-base.

The rate for mass concrete shall, in addition to B. (a) to B. (f) above, include for any formwork necessary unless otherwise stated in the item description.

5.15.2 Rod Reinforcement

The rate for rod reinforcement shall include all costs associated with the following:-

a) Supply rod reinforcement complying with the specifications.

b) Providing test certificates

c) Cutting, bending and fixing reinforcement including any welding were this is approved.

d) Providing and fixing all spacers, tying wire, chairs and stools.

5.15.3 Fabric Reinforcement

The rate for rod reinforcement shall include all costs associated with the following:-

a) Supplying fabric reinforcement complying with the specifications.

b) Providing test certificates

c) Cutting and fixing fabric reinforcement

d) Providing and fixing all spacers, tying wire, chairs and stools.

e) Providing the specified laps, fabric will be measured as the net plan area.

5.15.4 Sawn Formwork

The rate for rod reinforcement shall include all the costs associated with the following:-

a) Supplying, fixing, easing and striking all temporary forms as specified together with all temporary construction required for their support.

b) Supplying details or calculations for formwork.

c) Coating with material to prevent adhesion to the concrete.

d) Complying with specified minimum periods before removal of forms.

e) Back propping for multi-storey construction.

5.15.5 Wrought Formwork

The rate for wrought formwork shall include for all costs associated with the following:-

a) Supplying, fixing, easing and striking all temporary forms as specified together with all temporary construction required for their support.

b) Supplying details or calculations for formwork.

c) Coating with material to prevent adhesion to the concrete.

d) Complying with specified minimum periods before removal of forms.

e) Back propping for multi-storey construction.

f) Providing sample panels of concrete as specified and removing on completion of the works.

5.15.6 Precast Concrete

The rate of precast concrete shall include for all costs associated with the following:-

a) Supplying concrete including items on the above clauses.

b) Supplying rod reinforcement including ditto.

c) Supplying fabric reinforcement (if applicable) including ditto.

d) Supplying, fixing, easing and striking moulds and formwork as specified including replacement after multiple use.

e) Producing drawings and details as specified.

g) Coating moulds with materials to prevent adhesion to the concrete.

h) Complying with specified minimum periods before removal of forms.

i) All handling, lifting and fixing of precast units.

5.15.7 Composite Floor Construction

The rate for composite floor construction is to include for all moulds, materials and all unspecified items necessary for the manufacture of hollow concrete blocks by the Contractor.

Another rate will be applicable in the event of the Contractor purchasing the block as specified from independent suppliers or manufacturers.

5.15.8 Waffle Floor Construction

The rate for waffle floor construction is to include for all moulds, materials and all items necessary for complying with the specification. The rate shall also be deemed to include for solid concrete margins and bearings.

6.0 STRUCTURAL STEEL WORK

6.0 STRUCTURAL STEEL WORK

6.1.0 QUALITY OF MATERIALS AND WORKMANSHIP

The quality of all materials and workmanship used in the execution of this Contract shall comply with the requirements of the most recent issues of the following British Standards and Codes of Practice, including all amendments to date of calling for Tenders.

a) BS.4 (Part 1) - Hot Rolled Sections

b) BS.4 (Part 2) - Hot Rolled Hollow Sections

c) BS.449 - The use of Structural Steel in building.

d) BS.638 - Arc Welding Plant, Equipment and Accessories.

e) BS.639 - Covered Electrodes for the Manual Metal Arc Welding of Mild Steel and Medium Tensile Steel

f) BS.916 - Black Bolts, Screws and Nuts

g) BS.1449 - Steel plate, sheet and strip

h) BS.1775 - Steel Tubes for Mechanical, Structural and General Engineering purposes.

i) BS.2994 - Cold Rolled Steel Sections

j) BS.4190 - IPSO Metric black hexagon bolts, screws and nuts

k) BS.4320 - Metal washers for general engineering purposes

l) BS.4360 - Weldable structural steel

m) BS.4848 - Hot rolled structural steel sections

n) BS.4872 - Approval testing of welders when welding procedure approval is not required

o) BS.5153 - General requirement for the Metal Arc welding of structural steel

p) BS.5493 - Protection of iron and steel structures from corrosion

The Architect may at any time require any materials to be tested in accordance with the requirements of the standards listed above. The cost of all successful tests shall be borne by the client, but the contractor/sub-contractor shall if required promptly supply at his own expense, test pieces as required by the architect. The costs of tests on materials failing to comply with this standard shall be borne by the contractor/sub-contractor. If in the opinion of the architect, faulty materials and/or workmanship have been used in the works, the contractor/sub-contractor may be directed to dismantle and cut out the parts concerned and remove them for examination and testing. The cost of dismantling, cutting out and making good to the approval of the architect shall be born by the contractor/sub-contractor.

6.2.0 FABRICATION

6.2.1 Cutting and Bending

All members, plates, brackets, etc. shall be neatly and accurately sheared, sawn or profiled to the required shape as shown on the drawings. Where steel is oxy-cut to shape, care shall be taken to preserve the full finished sizes required. If the members of plates are bent or set, the bends or sets shall be correctly made to the radii or angles specified without leaving hammer marks. The material may be heated to permit this. Materials that have been heated shall be annealed to approval.

6.2.2 Punching and Drilling

Holes for black bolts shall be drilled or punched 2 mm larger in diameter than the bolt used. Holes for high tensile friction grip bolts shall be drilled or sub-punched and reamed to 2 mm larger in diameter than the specified bolt sizes. All drilled holes shall be parallel sided and shall be drilled with the axis of the holes perpendicular to the surface. Badly drilled holes shall either be reamed out to approval and larger bolts fitted or otherwise as directed. All rough arises shall be ground off.

Holes for bolts in material thicker than 15 mm must be drilled. When holes are drilled in one operation through two or more thicknesses of material, the parts shall be separated after drilling and all burrs removed before assembly. Holes for bolts shall not be formed by a gas cutting process.

6.2.3 Tolerances

All members shall be fabricated with a tolerance in length of +0mm and –3mm, all not deviate from straightness by more than 1 in 400.

The allowance for angular twist shall be (3+0.6L)mm where L is the length of the member under consideration in metres. Twist shall be measured by placing the member as fabricated against a flat surface measuring the difference between the two corners of the opposite end.

The above tolerances shall be adhered to unless otherwise specified on the Architect's drawing.

6.3.0 FASTENING

6.3.1 Bolting

All bolts used shall be of such length that at least one full thread is exposed beyond the nut after the nut has been tightened. Where a nut or bolthead would bear on an inclined surface, a bevelled washer of the correct shape shall be interposed between the two surfaces. Bevelled washers shall not be allowed to get out of position during fabrication and erection and for this purpose may be spot welded to the steel surface. Bevelled washers for use with high tensile bolts may not be welded.

6.3.2 Black Bolts, Nuts and Washers

All black Bolts, Nuts and Washers shall comply with the requirement of BS.916 or alternatively BS. 4190 IPSO metric black hexagonal bolts screws and nuts.

6.3.3 High Tensile Bolts, Nuts and Washers, Friction Grip Bolts

All high tensile steel bolts, nuts and washers used in joints shall comply with the requirement of BS.3139 and shall be used in accordance with BS.3294.

6.4.0 ELECTRICAL WELDING

All welding shall be carried out in strict accordance with the requirement of BS.1856 and 938 and electrodes shall comply with BS.639.

Fusion faces shall be free from irregularities such as tears, fins, etc which would interfere with the deposition of weld metal.

Fusion faces shall be smooth and uniform and shall be free from loose scale, slag, rust, grease, paint, and/or other deleterious material.

All welds shall be of acceptable types, shall be of the finished sizes specified, and shall be carried out in such sequence that minimum distortion of the parts welded results.

Preparation of edges for welding shall be carried out by planning of machine flame cutting. Manual flame cutting may be permitted in certain circumstances.

Parts to be welded shall be maintained in their correct relative positions during welding, preferably by jigs.

Multiple run welds shall be carried out with each run closely following the previous run but allowing sufficient time for the proper removal of slag.

The contractor/sub-contractor shall ensure that each run is inspected and any unsatisfactory weld cut out and re-made to approval.

Welds in material 25 mm or greater in thickness shall be made by the Argon arc or similar and approved process, and special precautions shall be taken to prevent weld cracking.

Unless otherwise shown, the minimum size of fillet shall be 6 mm.

On completion, welds shall present a smooth and regular finish. Weld metal should be solid throughout with complete fusion between weld metal and parent metal and between successive runs throughout the joint.

Defects shall be cut out and made good to approval in sound weld metal.

The external faces of butt welds are to be ground smooth on completion and to be to the approval of the Architect.

6.5.0 SHOP AND FIELD CONNECTIONS

6.5.1 Rolled Sections

All shop connections shall be electric welded or bolted with high tensile friction grip bolts.

No bolts used shall be less than 12 mm diameter and no weld shall be less than 40 mm in length. At least two bolts shall be used in connections transmitting loads unless otherwise indicated by the Architect.

No weld of length less than four times the nominal fillet size shall be deemed capable of carrying a load.

Beam to column connections not detailed shall be on "Standard" top and bottom cleat connections with the load carried on the bottom cleat. "Standard" web connections shall be used for connecting beams to beams.

Field connections shall be as detailed, i.e. bolted with high tensile or black bolts in drilled holes. Black bolts in punched holes will only be permitted for connections carrying a designed load or for connections to timber members.

6.5.2 Structural Hollow Sections - Circular and Rectangular

Hollow Sections shall be connected by electric welding unless shown otherwise.

The design of welds shall be in accordance with Clause 53 and 54 and Appendix C of BS. 449.

Butt welds shall be made with the fusion surfaces of the ends of each member properly aligned.

6.6.0 ASSEMBLY

6.6.1 Trusses and Portal Frames

Trusses shall be carefully set out to the dimensions shown on the drawings.

Where it is required the trusses be cambered, such camber shall be provided by bending the bottom chord to the arc of a circle.

Notwithstanding any dimensions spacing of purlin cleats, the contractor/sub-contractor shall ensure that purlin cleat spacing is satisfactory for the available stock lengths of roof sheeting. However, the architect's approval must first be obtained before any alteration is made in purlin spacing or sheeting sizes.

Splices in portal and other frames shall be made where shown on the details or where indicated.

6.6.2 Boxed Members

Abutting edges of boxed members shall be connected and scaled with a continuous weld to exclude the entrance of moisture. Where specified, such welds shall be ground flush to approval.

6.6.3 Shop Assembly

Such assembly of units in the shop as is specified or necessary before transporting to the site will be inspected by the architect before painting. The work will be laid out in the shop or yard so that all parts are accessible for inspection and testing of the work.

The contractor/sub-contractor shall furnish all facilities for inspection and testing for the work and he must notify the architect on each occasion when the material is ready for inspection.

6.6.4 Marking

All members of the structure to be site assembled shall be match marked in accordance with the shop details and marking plans submitted for approval.

6.7.0 ERECTION

6.7.1 Site Dimensions

No erection shall commence before accurate Site Dimensions have been taken by the contractor/sub-contractor, and no claim will be considered should final dimensions differ form those on the drawings. Any modifications to the structural steel required in order to comply with Site Dimensions shall be made on the ground to the architect's approval before erection is commenced.

6.7.2 General Setting-Out Tolerances

The Temporary Bench Mark (TBM) which shall be located at the Structural Ground Floor Level (S.G.F.L.) having been agreed on site between the architect and the contractor, shall be considered as the site datum.

The datum points for the setting out of the datum lines passing through TBM at all floor and roof levels shall be:+/- Om.

The Permissible Deviation from the TBM and DL shall be as follows:-

a) Setting out on Plant at S.G.F.L.

All setting out dimensions with respect to each datum line (i.e. P.D. from "x" and "y" plan axes) = +/ - 10 mm/30 metres.

b) Transfer of TBM to Structural First Floor, intermediate floor and roof levels

With respect to the TBM at S.G.F.L., the TBM at:

First Floor Level	-	+/ - 5 mm
Intermediate Floor Levels	-	+/ - 10 mm
Roof Level	-	+/ - 15 mm

b) Setting out on plan or upper floors with respect to the transferred TBM.

All setting out of dimensions with respect of each datum lines
= +/ 10 mm / 30 metres.

c) The clear distance between adjacent elements at any level where accuracy
is required for doors, windows, services, secondary steelwork etc.

d) The P.D. with respect to the relevant TBM of the upper or lower surface of
any truss or element, taking into account specified cambers:

e) The Plumb vertical members: = + 10 mm / storey.

6.7.3 Equipment

All erection shall be carried out by competent and experienced men and the contractor/sub-contractor shall take every care to safeguard the public, workmen and adjoining property.

All gear used shall be of adequate strength and shall comply with all regulations current at the time.

The contractor/sub-contractor shall be held responsible for all damage caused to the structure, workmen, or buildings during erection.

6.7.4 Storing and Handling

Steel shall be stored and handled and erected in such a manner that no member is subjected to excessive stresses which could have an adverse effect on the properties of the steel. If in the opinion of the architect, the steel work has been subjected to such treatment, the contractor shall remove this steel from the site and replace it at his own expense.

6.7.5 Erection Details.

No member or part of a member which has been bent or distorted shall be erected in that condition. All straightening shall be done in the ground.

Columns shall be wedged to line and level on steel or cast iron wedges and checked by the Architect. After acceptance, column bases shall be grouted to approval before wedges are removed. Unless shown on the drawing, all columns shall be left truly vertical and correct to line and level. Beams, girts, etc. shall be erected level unless otherwise shown, and correctly positioned.

Trusses and open web joists shall be carefully handled at all times and when being erected shall be lifted at such points and in such manner as will prelude any possibility of damage from erection stresses.

Immediately after erection, each truss shall be made secure by purlins, bracing or guys to approval.

Bracing shall be placed in position as soon as dependent work will permit.

6.7.6 Field Connections

In making connections, drifting of unfair holes will not be permitted and holes not matching properly shall either be reamed or drilled out and a larger bolt inserted or otherwise as directed.

Holes formed or enlarged by oxy-cutting will be condemned and must be filled to approval by electric welding and red drilled.

Tightening and testing High Tensile Friction Grip Bolts:-

a) Before assembly, the contact surface, including those adjacent to the washers, shall be de-scaled or carry normal tight mill scale. They shall be free from dirt, oil, loose scale, burrs, paint (except priming paint) pits and other defects that would prevent solid seating of the parts.

b) Bolts shall be assembled with approved hardened flat or tapered washers as required between the bolthead and nut and the softer mild steel.

c) When bearing faces of the bolted parts have a slope of more than 1 in 20 with respect to a plane normal to the bolt axis, square smooth bevelled washers shall be used to compensate for the lack of parallelism.

d) All bolts shall be tightened by the "Turn of Nut" method. This method shall generally be as approved by the architect to achieve in all bolts a minimum tension equal to the proof load.

6.7.7 Grouting

Unless otherwise detailed on the drawings, a space of not less than twenty (20) mm and not more than forty (40) mm shall be provided between undersides of column baseplates and footings, and between all beam and roof truss bearings and concrete pads, etc.

After each column, beam, or roof truss has been wedged up to a line and level and fixed in position to approval, the space between footing or pad and the underside of the baseplates or steel member shall be grounded with a mixture of portland cement and approved washed sand.

The Portland Cement and sand shall be thoroughly mixed to approval in equal proportions by volume with only sufficient water to produce a mixture of "damp earth" consistency and shall be used within twenty minutes of mixing. The caulking mixture shall be packed to approval into the space between baseplate and foundation and protected from damage until set.

6.8.0 PAINTING

6.8.1 Painting Material

All paints are to be supplied by a supplier approved in writing by the architect.

Paints are to be delivered to the site in the original containers as supplied by the manufacturer with seals unbroken and are to be used in strict accordance with the manufacturer's instructions. Manufacturer's representatives are to be free to visit the site and inspect materials and workmanship, and if necessary take samples of materials for laboratory analysis.

Paints are not to be thinned unless instructed by the architect.

No external painting is to be carried out during rain or when rain is likely to occur before the paint has had time to dry. All surfaces are to be dry and free from moisture at the time of painting.

6.8.2 Preparation for Painting

All structural steel shall be thoroughly scraped and wire brushed to remove mill scale and rust. Dirt and grease or oil shall be washed off with white spirit and the steel allowed to dry.

6.8.3 Painting Process

A first coat of Red Oxide Zinc Chromate primer shall be applied in the works immediately the steel preparation has been completed. A minimum of 24 hours shall elapse before the steel is moved from its position whilst painting has been carried out. After delivery to site, the steel shall be carefully examined and all areas where the priming coat has been damaged and/or where rust has developed shall be washed with white spirit and wire brushed as necessary and a further priming coat as for the first applied to completely cover the damaged areas.

During erection, surfaces of steel which are to be in contact shall be painted with one further coat of primer as previously described and the surfaces brought together whilst the paint is still wet.

Bolts, Nuts, Washers, etc. shall after erection is completed to approval, be carefully de-greased with white spirit and painted as for steelwork.

Steel purlins and sheeting rails shall generally be painted as for steelwork except for purlins and rails supporting

aluminium sheeting when the following specifications shall be used:-

a) 1st coat - Red Oxide Zinc Chromate Primer

b) 2nd Coat - An approved Aluminium paint

The interior of mild steel gutters shall be prepared as previously described for structural steelwork.

7.0 WALLING

7.0 STANDARDS AND CODES OF PRACTICE

Requirements of the following British Standards and Codes of Practice and equivalent Uganda Bureau of Standards shall be observed:-

7.1.1 British Standards

a)	B.S. 3921 part 2	Bricks and blocks of fired brickwork clay
b)	B.S. 1180	Concrete bricks and fixing bricks
c)	B.S. 4729	Shapes and dimensions of special bricks
d)	B.S. 2028, 1364 type B	Precast concrete blocks (for general use and load bearing walls above damp proof course)
e)	B.S. 2028, 1364 type C	Precast concrete blocks (for internal non-load bearing walls)
f)	B.S. 1200 table 1 and 2	Sand for mortar for plain and reinforced brickwork, block walling and masonry.
g)	B.S. 890 part 2	Building limes (Hydrated Lime)
h)	B.S. 4721	Ready mixed lime: sand for mortar
i)	B.S. 4551	Methods of testing mortars and specifications for mortar mixing sand
j)	B.S. 743	Materials for damp proof courses.
k)	B.S. 1178	Milled sheet lead and strip for building purposes
l)	B.S. 1243 Fig.	Metal ties for cavity wall construction (vertical twist type)
m)	C.P. 111	Structural recommendations for load bearing walls.
n)	C.P. 121 part 1	Walling
o)	C.P. 122, 202 part 1	Masonry – rubble walls
p)	C.P. 122	Walls and partitions of blocks and slabs
e)	**NOTE:**	The contractor's attention is drawn to Section "G" of the Standard Method of Measurements.
f)	**WATER:**	Shall be as specified in "concrete work"

7.2.0 GENERAL

7.2.1 Samples and sample panels

Samples of all types of blocks, bricks and stone required for the works shall be produced to the architect for his prior written approval before any orders are placed. After approval of samples, the contractor shall erect 1200 mm x 1200 mm sample panels as required by the architect. No work shall be commenced until written approval has been given to sample panels, which shall be maintained for the duration of the work to which the sample applies. Any work inferior to approved samples shall be taken down and removed if required by the architect. The cost of providing samples and sample panels shall be deemed to be included in the contract sum.

7.2.2 Pricing

Rates for walling are to include for reinforcement strips.

Labours on stone walling stated in the Standard Method of Measurement as to be included shall be deemed to include for redressing the beds of stone on site to the minimum extent necessary to obtain uniformity of coursing and for any redressing of faces necessary to bring the thickness within the tolerance specified.

Rates for walling of any description are to include for all expenses in connection with the provision and conveyance of samples of walling materials to the Kenyan Ministry of Works, Materials Testing Laboratory, Nairobi.

7.3.0 MATERIALS

7.3.1 Cement

Cement shall be as described in Concrete Work.

7.3.2 Aggregate

Fine aggregate or sand for concrete blocks shall be as described in Concrete Work.

Coarse aggregate or ballast for concrete blocks shall be good, hard, clean aggregate from approved quarries. It shall be free from all decomposed materials and shall be graded up to 10 mm and all as described for coarse aggregate or ballast in Concrete Work.

7.3.3 Limes

Hydrated limes for cement/lime mortar shall comply with K.S. 02-97 sem-hydraulic or non-hydraulic calcium limes. Lime for lime/sand mortar shall comply with K.S. 02-97 and shall be hydraulic.

7.3.4 Sand for mortar

Sand for mortar shall comply with B.S. 1200.

7.3.5 Concrete blocks

Concrete blocks for walling shall comply with B.S. 6073 part 1, solid or hollow two-hole type as specified, and made in approved block making machines, under cover, of a composition as follows:-

a) Portland cement 1 M^3

b) Fine aggregate (graded up to 5 mm) 3 M^3

c) Course aggregate (graded up to 10 mm) 6 M^3

The compressive strength of non load bearing blocks shall be not less than:-

d) Average 10 blocks 3.5 N/sq mm, gross area

e) Lowest individual block 2.8 N/sq mm, gross area

When load bearing, the compressive strength of blocks shall be:-

f) Average of 10 blocks 7.0 N/sq mm, gross area

g) Lowest individual block 5.6 N/sq mm, gross area

All testing shall be in accordance with B.S. 2028.

Newly made blocks shall be carefully deposited on racks under sheds and then left for three days and kept thoroughly wet the whole time, after which they shall be put out in the open on racks and protected with approved matting, sacking or straw and kept wet for a further five days, then kept in the same position and under same mat cover, but without wetting, for a further seven days to season.

Blocks to be subsequently covered with an in-situ finishing may be slightly rough in texture. Fair-face blocks shall be perfectly smooth.

7.3.6 Precast concrete louvre or screen blocks

Precast concrete louvre or screen blocks shall comply in all respects with the specification for precast items contained in the "Concrete

Work" specification and shall be constructed to the dimensions and form shown in the drawings.

7.3.7 Stone

Stone shall be sound and hard and free from all defects and shall be obtained from a quarry approved by the architect.

All stone required for walling (unless otherwise described), shall be chisel dressed into true rectangular blocks with each surface even and at right angles to all adjoining surfaces. Ordinary walling shall be built in 190 mm courses, and of the thicknesses given herein with all dimensions having a tolerance of plus or minus 6 mm. At least 80% of all stone blocks shall be not less than 500 mm in length and no block will be allowed to be cut or redressed after it is built into the work.

7.3.8 Damp-Proof course

Bituminous felt sheeting for damp-proof courses shall be three-ply heavy duty hessian based felt in accordance with B.S. 743 Ref. "A" weighing not less than 3.8 kgs per square metre. The sheeting is to be lapped 150 mm at running joints and the full width of walls at angles.

7.4.0 WORKMANSHIP

7.4.1 Storage of materials

a)	Cement, sand and limes	As described in concrete work.
b)	Blocks and bricks	Open stacked to permit ventilation and protection from the sun, rain and rising damp.

7.4.2 Wetting blocks, bricks and stone

Blocks bricks and stone shall be wetted as necessary before and after laying. Walls shall be kept wet for three days after building.

7.4.3 Bonding Walls

The blocks shall be properly bonded together and in such a manner that no vertical joint in any one course shall be within 115 mm of a similar joint in the course immediately above or below. Sufficient through-bonders shall be provided. Alternate courses of walling at all angles and intersections shall be carried through the full thickness of the adjoining walls. All walling shall be built up entirely solid in blocks, without voids, allowance being made for only 10 mm thick joints. All

perpends, reveals and other angles of the walling shall be built strictly true and square.

7.4.4 Generally

The contractor shall provide all setting out rods.

Walling shall not be built on concrete foundations until at least four days after casting.

All blockwork and brickwork shall be built uniform, true and level, with all perpends vertical and in line. No work shall rise more than 1 metre above adjoining work and all such risings are to be properly raked back in long steps to prevent cracks. Risings and all walls shall be leveled around at each floor.

Joints generally are not to exceed 10 mm in thickness. Cutting of blockworks against concrete soffites, etc. shall include for cutting to give normal 10 mm joints and complete filling thereof with mortar.

All walls built in hollow concrete blocks, where finishing with an open top edge, (i.e. not against ceiling, beams, etc) or at the underside of cills, shall be finished with a solid concrete block top course.

Openings for wooden doors, frames, windows, hatches, ventilators, etc. are to be set out and left unbuilt until the wooden frames have been fixed in position.

Openings for metal frames are to be wide enough for the frames to fit without being forced into position. Lugs shall be built into joints and the space between walling and frame filled with cement mortar well tamped into the channel of the frames and pointed all round.

7.4.5 Wall reinforcement

Where walls or partitions are constructed of blocks of stones less than 150 mm thick, they shall be reinforced with a 25 mm wide strip of 2 mm thick hoop iron built into alternate horizontal joints in the wall centre. The hoop iron shall be lapped and hooked at running joints, angles and intersections and carried at least 115 mm into abutting walls and junctions.

7.4.6 Mortar mixing

The constituent materials shall be measured separately when dry in specially prepared gauge boxes of sizes to give the proportions specified without consolidation of the contents by ramming and shaking. The mortar shall be mixed in an approved power driven mixer for not less than two minutes per batch and using the minimum quantity of water necessary to obtain a working consistency. The mixer

shall be used as close as practicable to the works and mortar shall be used within 30 minutes of mixing. Partially or wholly set mortar shall not be used or re-mixed.

7.4.7 Bedding and pointing

All blocks shall be bedded on a solid bed of mortar; vertical faces of block shall be well buttered before being laid and the whole well grouted at each course. Joints of blockwork to be plastered shall be roughly raked out to form a key. Joints of air face blockwork shall be either finished flush or finished recessed 6 mm as specified.

7.4.8 Stone Walling

Stones are to be selected for size and colour and dressed on face to match existing and neatly bonded in. The stones are to be bedded in cement mortar and pointed with a neat recessed joint and upon completion the faces are to be well washed down and wire brushed.

7.4.9 Fair-face work

Walling of any material required to be fair-faced shall be of selected materials, uniform, and even in appearance with joints neatly executed as specified.

7.4.10 Holes and chases

Where walling is cut, holed or chased for conduits, pipes or the like, all such chases shall be filled in solid with cement mortar mix (1:4) prior to the application of finishes. In no case shall a vertical chase be deeper than one third the thickness of the wall and in no case shall a horizontal chase be deeper than one sixth of the thickness of the wall.

Putlog holes shall be not less than one course deep, afterwards filled with a block cut neatly fit.

8.0 ASPHALT WORK

8.0 ASPHALT WORK

8.1.0 STANDARD AND CODES OF PRACTICE

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

8.1.1 British Standards

a)	B.S. 1162, 1410 and 1418	Mastic asphalt for tanking and damp-proof courses (Natural rock asphalt aggregate)
b)	B.S. 988, 1097, 1076 and 1451	Mastic asphalt for tanking and damp course (limestone aggregate)
c)	C.P. 102	Protection of building against water from ground.
d)	**NOTE:**	The contractor's attention is drawn to Section "j" of the Standard Method of Measurement.

All asphalt shall comply with the requirements of subsections B.S. 1418 and 1097 and C.P. 102 specifically dealing with tanking operations.

8.2.0 MASTIC ASPHALT FOR TANKING

The contractor shall arrange for the work to be executed by an approved sub-contractor. No other sub-contractor will then be permitted to be employed without the written authority of the architect.

Tropicalised mastic asphalt is to comply with B.S. 1097/1966 and B.S. 1418 applied in three coats, in the case of horizontal work on and including sheathing felt; in the case of vertical work without sheathing felt. The third and final coat is to have a polished finish. All tanking operations to comply with C.P. 102.

The contractor is to take all necessary precautions to protect finished work, and it is his responsibility to ensure that no damage occurs to surfaces during subsequent building operations or any reasons whatsoever.

For tanking to basements, lay over the whole area of the basement concrete floor, a horizontal damp proof course in three thicknesses laid with 150 mm laps to one course of foundation walling on outer

face of wall with a vertical damp proof course with a double angle fillet.

Vertical faces of basement walls shall then be covered with a damp proof course applied in three thicknesses with 75 mm laps to a total thickness of not less than 20 mm.

Vertical damp-proof courses shall be carried up to a minimum height of 150 mm above ground level and connected at bottom to horizontal damp-proof coursed-in walls with double fillet formed on top of foundations to form a complete tank to basement.

All junctions between horizontal and vertical asphalt shall be warmed, cleaned and properly made good with two-coat angle fillets a all internal angles.

Properly made good joints between lining pits and horizontal damp proof courses to floor shall be effected and double angle fillets to all internal angles maintained.

It is essential that continuity of tanking be maintained. Care must be exercised to ensure that such continuity is not destroyed by stanchions, pits, sumps, etc.

Protect asphalt by the application of loading coats immediately each section of work is complete. Pumping of any water gaining access shall be continued until not only the asphalt work is complete, but also until loading coats are thoroughly set.

If the water level is near, such water level shall be maintained at not less than 0.3 m below the level of the base concrete during the progress of tanking work to avoid the application of asphalt on wet surfaces and this pumping operation shall be maintained until the temporary sump has been filled and sealed.

9.0 ROOFING

9.0 ROOFING

9.1.0 ROOFING SHEETS PRE-PAINTED MILD STEEL/G.C.I. SHEETING

9.1.1 Generally

Pre-painted corrugated mild steel sheeting shall be No. 24 Gauge of best quality in accordance with B.S. 3038, and shall conform to Uganda Bureau of Standards.

9.1.2 Laps

Sheets shall be laid with 150 mm end laps and side laps of 30 mm corrugations on the side away from the prevailing wind.

9.1.3 Fixing of steel and timber

The sheets shall be fixed to mild steel angle purlins with 6 mm diameter pre-painted mild steel hook bolts 50 mm longer in the shank than the depth of the steel purlins to which they are fixed each with one diamond shaped bitumen washer, one, pre-painted steel washer, and one pre-painted steel nut. The sheets shall be fixed to timber purlins by using 14 gauge drive screw with bituminous felt washer backed by cranked diamond shaped aluminium washer.

9.1.4 Holes

Holes for bolts or screws shall be punched from the inside of the sheet and through the ridges of corrugations NOT in the hollows. A clearance of 0.80 mm on the bolt or screw must be allowed.

9.1.5 Ridges, Valleys, Flashings

The ridges, valleys, flashings etc. shall be formed of No. 24 gauge pre-painted mild steel sheeting of a quality equal to the sheeting on each side at 450 mm centres maximum with 6 mm diameter seam bolts 20 mm long each with one diamond shaped bitumen washer, one pre-painted steel washer and one pre-painted steel nut.

Ridges and valleys shall not be less than 375 mm girth.

9.1.6 Bolts and Screws

All fixing bolts and screws shall comply with B.S. 1494.

9.1.7 Square Abutments

At the square abutments, the last two corrugated of the corrugated iron sheets next to wall shall be flattened and turned up against wall and covered with 24 gauge pre-painted sheet iron apron flashing.

9.1.8 Bat Proofing

Bat proofing shall consist of "Perspex" or other equal and approved translucent plastic corrugated sheetings.

9.2.0 TILED ROOFING

9.2.1 Concrete single-pin tiles and fittings

Concrete single-pin tiles and fittings shall comply to B.S. 473 and 550: Part 2 group B. Tiles are to be 381 x 229 mm nominal unless otherwise specified.

9.2.2 Concrete single-pin tiles and fittings

Surface coating, when specified must be firmly bonded. A full range of fittings are available from the manufacturer and must match the tiles with which they are laid.

9.2.3 Mangalore Tiles

Mangalore tiles where specified, shall be interlocking clay tiles as manufactured by M/s Clayworks Ltd. or other equal and approved. They shall be uniform in size, shape and colour, hard, well burnt and free from defect.

They shall be laid in accordance with the manufacturer's printed instructions.

9.2.4 Polythene Underlay

Polythene shall conform to B.S. 3012: 500 gauge and of approved manufacture.

9.2.5 Nails for underlay

Nails for underlay shall comply to B.S. 1202: Part 1.

9.2.6 Tying Wire

Tying Wire shall comply to B.S. 443, 1.6 mm diameter (16 S.W.G.) iron wire.

10.0 CARPENTRY

10.0 CARPENTRY

10.1.0 STANDARDS AND CODES OF PRACTICE

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

10.1.1 British Standards

a)	B.S. 565	Glossary of items relating to timber and woodwork
b)	B.S. 1860 part 1	Structural timber. Measurements of characteristics affecting strength (softwood)
c)	B.S. 4471	Dimensions for softwood
d)	B.S. 373	Methods of testing small clear specimens of timber.
e)	B.S. 1202 part 1	Nails
f)	B.S. 1579	Connectors for timber
g)	B.S. 4169	Glued laminated structural members
h)	B.S. 916	Black bolts

10.1.2 Codes of Practice

a)	C.P. 112	The structural use of timber
b)	C.P. 98	Preservative treatment for construction timber.
c)	**NOTE:**	The contractor's attention is drawn to Section "L" of the Standard Method of Measurement.

10.2.0 DEFINITIONS

10.2.1 Selected

The term 'selected' shall be deemed to include keeping the material so described clean for staining, polishing, or any similar finish.

10.2.2 Hardwood or the like

The term 'hardwood or the like' which is used as a statement to which ironmongery is to be fixed, shall be deemed to include plywood and other manufactured materials, except when faced with metal, laminated plastics or the like.

10.3.0 MATERIALS

10.3.1 Terminology

All technical terms shall be as defined in the Glossary of Terms used in Timber Standards, KS. 02 1976 and, where applicable, the British Standard Code of Practice No. 112.

10.3.2 Timber Generally

Timber shall be sound, well conditioned, properly seasoned, containing not more than 15% moisture for joinery work or 18% moisture for carpentry work, and complying with the following performance specification:-

10.3.3 Performance Specifications

These specifications refer to all conifer (soft-wood) and broad leaved (hard-wood) species and apply to timber sections incorporated in the building after they have had a sufficient time to season. The period required for green timber to season fully after installation under cover shall be assumed to be one month for each 25 mm thickness.

Unless noted elsewhere, timber shall conform to the listed specifications as follows:-

a)	F	Grade	Furniture and high class joinery
b)	GJ	Grade	General joinery
c)	S75	Grade	Structural grade having grade stress value of 75% of basic stress.
d)	S50	Grade	Structural grade having grade stress value of 50% of basic stress.
e)	C	Grade	A general construction grade for non-stressed construction.

f) L Grade A low grade for low quality work.

Defects shall not exceed those specified in Tables, 1, 2, & 3 of KS 02-17.

10.4.0 GENERAL

All timber used for carpentry shall be sound, well conditioned, properly seasoned to suit particular use and free from defects or combination of defects rendering it unsuitable for the purpose intended.

Timber used for carpentry shall be in accordance with the latest approved Grading Rules issued by the Government of Kenya (Legal Notice No. 358). Timber used structurally shall comply with the requirements of the Export Grading rules made under the Export of Timber Act (Kenya), Second or Select Grade, and also with B.S. 1860.

The following timber shall be used:-

a) Cypress

b) Podocarpus (podocarpus spp)

c) Cedar (Junipers Procera)

d) Elgon Olive

All timber shall be free of live borer, beetle or other insect attack when brought upon on site. The contractor shall be responsible, to the end of maintenance period, for executing at his own cost, all the work necessary to eradicate insect attack of timber attacked or suspected to be attacked, notwithstanding that the timber concerned may have already been inspected and passed as fit for use.

Timber shall be seasoned to a moisture content of not more than 18%.

All carpentry timbers shall be treated with pressure impregnated "Celcure" or "Tenalith" solution with a minimum wet retention of 5.46 kg of dry salt per m^3. If so required "charge sheets" issued after treatment with "Celcure" or "Tenalith" shall be submitted by the contractor to the architect for his retention. All out ends and other cut faces or timbers sawn after treatment shall be treated before fixing with "Celcure B" or "wolmanol" solution brushed on.

The contractor's rates for such timber hereinafter must allow for the above treatment.

All grounds shall be podocarpus or other light and approved hardwood.

Nails shall comply with the relevant standard as above.

Black bolts shall comply with B.S. 916.

Rag bolts, coach screws and others shall comply with B.S. 1494.

Where used externally, nails and screws shall be sherardized.

Timber shall be delivered early to the site, stored under cover clear of the ground and protected from the sun and dampness.

The architect shall be given facilities and reserves the right for inspection of all works in progress whether in workshop or on site. The contractor is to allow for testing of pro-types of special construction units and the architect shall be at liberty to select any samples he may require for the purpose of testing i.e. for moisture content or identification, species, strength, etc.

The contractor is to clear out and destroy or remove all cut ends, shavings and other wood waste from all parts of the building and the site generally, as the work proceeds and at conclusions of the work.

The clearance, destruction and removal is to prevent accidental borer infestation and to discourage termites and decay.

All carpentry work shall be accurately set out in strict accordance with the Drawings and shall 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 directed and approved and the rates shall be deemed to allow for these.

Carpentry work shall be left with sawn faces except where specified to be wrot.

All timber shall be as long as possible in length in order to minimize joints. Where joints are unavoidable, surfaces shall be in contact over the whole area of the joint before fastenings are applied.

No nails, screws and bolts are to be fixed in any split end. If splitting is likely, or is encountered in the course of work, holes for nails are to be prepared at diameters not exceeding $4/5^{th}$ of the diameter of the nails. Clenched nails must be bent at right angles to the grain.

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

11.0 JOINERY

11.0 JOINERY

11.1.0 STANDARD AND CODES OF PRACTICE

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

11.1.1 British Standards

a)	B.S.	565	Glossary of terms relating to timber and woodwork.
b)	B.S.	4471	Dimensions for softwood
c)	B.S.	1186 Part 1+2	Quality of timber and workmanship in joinery
d)	B.S.	373	Methods of testing small clear specimen of timber
e)	B.S.	4512	Methods of test for clear plywood
f)	B.S.	1142 part 3	Fibre building board (Insulation board softwood)
g)	B.S.	3444	Blockboard and laminated board
h)	B.S.	1445	Plywood manufactured from tropical hardwoods
i)	B.S.	3794	Decorative laminated plastic sheets
j)	B.S.	459 part 2	Flush doors
k)	B.S.	459 part 3	Fire check flush doors and wood and metal frame (1.5 hour and 1 hour types)
l)	B.S.	1567	Wood door frame and linings
m)	B.S.	584	Wood trims (softwood architrave skirtings, quadrants, etc)
n)	B.S.	1204 parts 1+2	Synthetic resin adhesive (phenolic and type MR-Moisture amino plastic) for wood Resistant Type INT - Interior
o)	B.S.	1210	Wood screws
p)	B.S.	1494 part 2	Fixing accessories for building purposes (bolts, screws, staples, etc)
q)	B.S.	4174	Felt tapping screws and metallic drive screws.

11.1.2 Codes of Practice

a) C.P. 201 Timber flooring

b) C.P. 201 parts 1+2 Flooring of wood and wood products

c) C.P. 151 Doors and windows including frames and linings

d) **NOTE:** The contractor's attention is drawn to Section "M" of the Standard Method of Measurements.

11.2.0 DEFINITIONS

11.2.1 Selected

The term "selected" shall be deemed to include keeping the material so described clean for staining, polishing, or any similar finish.

11.2.2 Hardwood or the like

The term "hardwood or the like" which is used as a statement to which ironmongery is to be fixed, shall be deemed to include plywood and other manufactured materials, except when faced with metal, laminated plastics or the like.

11.3.0 MATERIALS

11.3.1 Terminology

All technical terms shall be as defined in the Glossary of Terms used in Timber Standards, KS 02 1976 and, where applicable, the British Standard Code of Practice No. 112.

11.3.2 Timber Generally

Timber shall be sound, well conditioned, properly seasoned, containing not more than 15% moisture for joinery work or 18% moisture for carpentry work, and complying with the following performance specification:-

11.3.3 Performance Specifications

These specifications refer to all conifer (soft-wood) and broad leaved (hard-wood) species and apply to timber sections incorporated in the building after they have had a sufficient time to season. The period required for green timber to season fully after installation under cover shall be assumed to be one month for each 25 mm thickness.

Unless noted elsewhere, timber shall conform to the listed specifications as follows:-

a)	F	Grade	Furniture and high class joinery
b)	GJ	Grade	General joinery
c)		S75	Grade Structural grade having grade stress value of 75% of basic stress.
d)	S50	Grade	Structural grade having grade stress value of 50% of basic stress.
e)	C	Grade	A general construction grade for non-stressed construction.
f)	L	Grade	A low grade for low quality work.

Defects shall not exceed those specified in Tables, 1, 2 & 3 of KS 02-17.

11.4.0 WORKMANSHIP

The timber for joinery shall be as specified in the Export Timber Ordinance of 1951 and obtained from an approved sawmill. All such timber shall be Prime Grade and reasonably straight, grained and shall be purchased immediately the contract is signed. It shall be open stacked on site for such further seasoning as may be required.

Timber which in the opinion of the architect does not satisfy the specification in character or condition or is not suitable for the requirements of the work because of the blemishes it contains shall not be used.

The following timber shall be used:-

a) Podocarpus

b) Mvule

c) Cedar

d) Elgon Olive

e) Elgon Teak

f) Camphor

g) Mahogany

h) Meru Oak

i) Pamba Coffee

j) Nkalati

All timber shall be wrot by machine dressings. Non-exposed faces and machine marks shall be removed with hand plane and sanded out, unless otherwise specified.

The dimensions and thickness stated in the Bills of Quantities are the finished sizes (unless otherwise stated) and the contractor will allow for all necessary waste.

The joinery shall be worked strictly in accordance with drawings, and is to be framed up and put together as soon as possible and stored in the drying room, for as long as possible before being wedged up. All joints and angles are to be glued and where necessary cross tongued with hardwood tongues and surfaces finished clean and smooth, with machine marks sand-papered out before fixing.

Should any of the joinery work shrink, warp, wind or deflect unduly before the end of the maintenance period of the contract, the work is to be taken down and rectified at the contractor's sole expense.

Tolerance in thickness shall conform with the following extracts from the Government of Kenya Grading Rules:-

Hardwood Grading: (First and Second Grades):-

a) 1.6 mm over size on pieces up to 25 mm in thickness

b) 3 mm oversize on pieces over 25 mm and up to 51 mm in thickness

c) 6 mm over size on pieces over 51 mm in thickness; undersize will not be permitted.

d) Softwood Grading: Appearance Grades (First and Second Grades); undersize will not be allowed.

e) Oversize: All timber to be sawn oversize b 1.6 mm per 25 mm of thickness and width. Not more than 3 mm in thickness and not more than 6 mm in width.

Seasoning of timber shall be to moisture content of not more than 15%.

Pressure impregnation treatment shall be as for "Carpentry".

Where joinery is described as screwed, this is deemed to include sinking the head of the screw and pellating with similar timber, and to grain in with the finished joinery.

All hardwood joinery shall be finished for oil paint/varnish, unless otherwise stated.

The rates shall be deemed to allow for all nails and screws and fixing, all labour, cuttings, notching, halving, morticing, tenoning and wedges except where otherwise provided.

All work described as plugged shall be fixed with screws to plugs formed by drilling concrete walls, etc., with the proper tool of suitable size at 750 mm spacing and filling the holes completely with "philplug" rawl plastic or rawl plugs in accordance with the manufacturer's instructions. Alternatively and where so agreed by the architect, hardwood dovetailed fixing slips in preservative and cut and primed or bedded in cement mortar (1:3) may be used.

The rates are to allow for all surfaces of joinery where in contact with walling or plaster, or where otherwise unexpected being treated before fixing with two coats of approved wood preservative.

Laminated plastic sheeting shall be "formica" manufactured by M/s Thomas de la Rue and Co. or equal and approved, 1.6 mm thick and accurately fixed with approved type water-proof impact adhesive and in the colours selected by the architect.

Blockboard shall comply with the standard as mentioned above.

Plywood shall comply with the standard as mentioned above and faced both sides unless otherwise stated.

Fibreboard shall be 12.7 "Celotex" or other equal approved softboard.

All joinery work shall be accurately set out and framed together soon after commencement of the building as is practicable but not to be wedged up or glued until the building is ready for fixing the same. Any portions that warp, wind or dent shall be removed and new ones fixed in their place together with other work which may be affected thereby all at the contractor's expense.

All work shall be properly morticed, tennoned, housed, shouldered, dovetailed, notched, primed, bradded, etc. as directed and to the satisfaction of the architect and all glued up with the best quality glue.

Joints in joinery shall be as specified or detailed, and so designed and secured as to resist or compensate for any stresses to which they may be subjected. All nail strings, etc. are to be punched and puttied. Loose joints are to be where provisions for shrinkage is necessary; glued joints where shrinkage need not be considered and where conditions may be damp must be of the resin type. For non-load-bearing joints or where dry conditions may be guaranteed resin or organic glues may be used. All exposed surfaces for joinery shall be wrot and all arises "cased off" by planning and sand papered to an approved finish suitable to the specified treatment.

3 mm reduction of specified sizes will be allowed to each wrot face except in members 25 mm thick or less or where, described as finished sizes in which case joinery shall hold up the full dimensions.

In fixing all beads, fillets and small members shall be fixed with round or oval brads or nails well punched in and stopped. All large members shall be fixed with screws. Brass screws shall be used for fixing of all hardwoods, to the heads in and pellated over with wood pellets to match the gain.

Rates shall include for bedding frames, cills, etc in mortar or dressing surfaces of walls, etc in lieu.

Round wood plugs shall not be used, and screws or plugs shall be spaced at 750 mm centres.

All fixed joinery which in the opinion of the architect is liable to become bruised or damaged in any way shall be completely cased and protected by the contractor at his own expense until completion of works.

Bottom edges of doors shall be painted or polished with two coats of approved primer before fixing.

11.5.0 PARTICULAR SPECIFICATIONS

11.5.1 Chipboard

Chipboard shall comply with B.S. 5669.

11.5.2 Blockboard

Blockboard shall be approved imported or local manufacture complying in all aspects with B.S.1142 of the thickness specified and softwood faced both sides unless otherwise described. Samples of blockboard veneered with hardwood as specified, shall be

submitted to the Architect for his approval before any orders are placed.

11.5.3 Fibreboard

Fibreboard shall be "Celotex", or other equal and approved make, 12mm thick and complying in all aspects with the requirements of B.S. 1142.

11.5.4 Hardboard

Hardboard shall be tempered and of approved manufacture, in accordance with B.S.1142, suitable for painting, prepared and fixed in accordance with the makers' instructions.

11.5.5 Medium Density Fibreboard (MDF)

MDF shall be used wherever possible in place of blockboard or chipboard. The MDF used shall be to the thickness specified, shall be flat, smooth, straight, without any imperfections, surface distortion, broken or chipped edges. MDF used in damp locations (i.e. toilets) shall be moisture resistant MDF.

11.5.6 Laminated Plastic Sheeting

Laminated plastic sheeting shall be 1.5mm "Formica" or other approved sheeting complying with B.S.3794 Class 1, in colours to be selected by the Architect.

Prior to fixing laminated sheeting, the Contractor shall obtain the Architect's written approval to a sample.

11.5.7 Pressure Impregnated Treatment

All timber so described is to be vacuum pressure impregnated with "Celcure A" preservative to a dry salt nett retention of 10.5 kg "Celcure A" per cubic metre of timber and stacked until the moisture content returns to 18% or 15% as above described. Timber to be treated shall be machined to finished sections and cut to component lengths before impregnation. Cut ends, notchings, borings and faces of timber sawn after treatment are to be swabbed literally on cross cut ends with "Walmanol" end grain preservative, allowed to dry, and then applied in a similar manner a second time.

12.0 IRON MONGERY

12.0 IRON MONGERY

12.1.0 STANDARDS AND CODES OF PRACTICE

12.1.1 British Standards

a)	B.S. 1227 part 1 A	Hinges
b)	B.S. 2028	Performance test for locks
c)	B.S. 2911	Letter plates
d)	B.S. 4112	Performance requirements for hardware for domestic furniture
e)	NOTE:	The contractor's attention is drawn to Section "M" of the Standard Method of Measurement

12.2.0 MATERIALS AND WORKMANSHIP

All locks and ironmongery shall be fixed with screws, etc to match. Before woodwork is painted, handles shall be removed, carefully stored and re-fixed after completion of painting and locks oiled and left in perfect working order.

All keys shall be labelled with the door reference on labels before handing to the architect on completion. All ironmongery shall be carefully protected until completion of the work and any damage is to be made good at the contractor's expense.

Rates shall allow for easing and adjusting all doors, etc and for lubricating all locks, hinges, etc. and left in perfect working order.

Where descriptions fixing ironmongery include catalogue numbers, such items shall be obtained from the specified manufacturers if at all possible.

Rates shall include for labelling all keys with door references as directed by the architect.

All keys shall be provided with two keys and no keys are to pass the ward of any but its own.

13.0 METAL WORK

13.0 METALWORK

13.1.0 STANDARDS AND CODES OF PRACTICE

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

13.1.1 British Standards

a)	B.S. 4 part 1	Structural steel, hot rolled screws
b)	B.S. 4 part 2	Structural steel, hot rolled hollow sections.
c)	B.S. 325	Black cup and countersunk bolts and nuts.
d)	B.S. 916	Black bolts screws and nuts.
e)	B.S. 4174	Self tapping screws and metallic drive screws.
f)	B.S. 405	Metal washers for general engineering purposes.
g)	1161 and addendum	Aluminium and aluminium alloy sections for general engineering purposes.
h)	B.S. 938	Metal ore welding of structural steel tubes.
i)	B.S. 1856	Metal ore welding of mild steel.
j)	B.S. 729 part 1	Hot dip galvanized coating iron and steel articles.
k)	B.S. 1474	Wrot aluminium and aluminium alloy
l)	B.S. 990 parts 1+2	Steel windows (domestic and similar buildings)

13.1.2 Codes of Practice

a)	C.P. 499	Metal railings and balustrades.
b)	C.P. 117	Composite construction in structural steel and concrete.
c)	C.P. 2008	Protection of iron and steel structures from corrosion.
d)	C.P. 3012	Cleaning and preparation of metal surfaces.
e)	NOTE:	The contractor's attention is drawn to Section "P" of the Standard Method of Measurement.

13.2.0 MATERIALS AND WORKMANSHIP

Iron and steel where galvanised shall comply with the requirements of B.S. 729, part 1 entirely coated with fine fabrication by complete immersion in a zinc bath in one operation and all excess carefully removed.

The finished surfaces shall be clean and uniform.

All work in aluminium shall comply with the requirements of the standard mentioned above.

All smiting and bending shall be soundly and neatly executed, care being taken not to overheat.

All strap bolts and similar work shall be forged neat and clean from the anvil.

All welded connections shall be ground to a smooth finish and rates shall be deemed to allow for this.

Steel windows shall comply with the requirements of the standard mentioned above and shall be fixed in accordance with the manufacturer's instructions.

All mild steel except galvanised shall be cleaned of rust and scale, painted one coat red lead priming paint before delivering to site and the rates shall include for this.

14.0 FLOOR, WALL AND CEILING FINISHES

14.0 FLOOR, WALL AND CEILING FINISHES

16.1.0 STANDARDS AND CODES OF PRACTICE

The requirements of the following British Standards and Codes of Practice shall be observed.

British Standards

a)	B.S. 1191 Part 1 Class B	Gypsum building plaster (excluding premixed light weight plasters)
b)	B.S. 1193	Standard for internal plastering with gypsum plasters.
c)	B.S. 1199 Table 1	Sands for external renderings, internal plastering with lime and Portland Cement, and floor screeds.
d)	B.S. 1201	Aggregate for granolithic concrete floor finishes.
e)	B.S. 1281	Glazed ceramic tiles and tile fittings for internal walls.
f)	B.S. 1369	Metal lathing (steel for plastering)
g)	B.S. 890 Class A	Building limes
h)	B.S. 1187	Wood block for floors
i)	**NOTE**:	The Contractor's attention is drawn to Section "S" of the Standard Method of Measurement.
j)	C.P. 211	Internal plastering
k)	C.P. 221	External rendered finishes
l)	C.P. 204	In-situ floor finishes
m)	C.P 202	Tile flooring and slab flooring
n)	C.P. 203	Sheet and tile flooring (cock, linoleum, plastics and rubber)
o)	C.P. 212 part 1+2	Wall tiling
p)	C.P. 209	Care and maintenance of floor surfaces

14.2.0 MATERIALS AND WORKMANSHIP

14.2.1 Cement

Cement shall be described in "Concrete"

14.2.2 Sand

Sand shall comply with the requirements of the Standards mentioned earlier.

14.3.0 LIME

Lime shall be non-hydraulic lime to satisfy the Standards mentioned above. It shall be obtained from an approved source. It must be freshly burnt and shall be slaked at least one month before using by drenching with water, well broken up and mixed and the wet mixture shall be passed through a sieve of 10 meshes to the square centimeter. Lime putty shall consist of freshly slaked lime as described above saturated with water until semi-fluid and passed through and fine sieve, it shall then be allowed to stand until superfluous water has evaporated and it has become of consistency of thick paste, in no case for shorter period of one month before being used during which it must be kept damp and clean and no portion of it allowed to become dry.

Alternatively, hydrated lime with 70% average calcium oxide content may be used and it must be protected from damp until required for use. It shall be soaked to a putty at least 24 hours before use.

14.3.0 CONCRETE BED OF SLABS

All concrete beds and slabs shall be thoroughly brushed clean, hatched if necessary and well wetted and flushed over with a cement and sand (1:1) grout immediately before screeds or paving are laid .

Screeds and cement paving shall be laid in accordance with the relevant British Standards and/or Codes of Practice and in alternate bays generally not exceeding 3.0m during any period of working hours with neat joints and shall be damp cured with sand or sawdust and kept damp for at least 7 days after laying.

As bays are formed batten strips must be used to retain the exposed edge of the screed.

Thicknesses and mixes of screeds are adjusted to suite the various top dressing and the Contractor must first ascertain what finish is intended to each specific area before the work of the laying screeds is put in hand.

Screeds shall be finished with a wood float for wood blocks and steel trowel for thermoplastic and similar tiles.

14.4.0 SURFACES TO BE PLASTERED

All surfaces to be plastered must be brushed clean and well wetted before plaster is applied. Joints of walling shall be raked and concrete hacked to form a key. Care shall be taken to see that paving and plastering do not dry out prematurely. Adequate time intervals must be left between successive coats in two coat work in order that the drying shrinkage of the undercoat may be substantially complete.

14.5.0 INTERNAL LIME PLASTER

To be applied in minimum two coats to finish not less than 12mm total thickness. The rendering coat shall be in the proportion of cement and sand (1:4) and the finishing coat not less than 1.50mm thick shall consist of fine sieved lime putty with 10% of cement thoroughly incorporated immediately before use, trowel led hard and smooth with a steel trowel and sprinkled with water during the process.

The first coat must be well scored to form a key and at least fourteen days must elapse between the completion of any portion of the rendering coat and application of the finishing coat.

14.6.0EXTERNAL CEMENT AND SAND RENDERING

External cement and sand rendering shall consist of cement and sand (1:4) applied in two coats and finished with wood float.

14.7.0 SAMPLES

If required the Contractor shall prepare samples of the screeds, pavings and plastering as directed until the quality, texture and finish required is obtained and approved by the Architect, after which all work executed shall conform with the respective approved samples.

14.8.0 SCREEDS AND PAVINGS

All screeds and pavings shall be finished smooth, even and truly level, unless otherwise specified and paving shall be steel trowel led.

14.9.0 FINISHING

Rendering and plastering shall be finished plumb, square, smooth, hard and even and junctions between surfaces shall be perfectly true straight and square.

All work not found to be of satisfactory standard shall be hacked away and made good at the Contractor's expense.

Partially or wholly set materials will not be allowed to be used or re-mixed. The plaster etc., mixes must be used within two hours of being combined with water.

14.10.0 GRANOLITHIC PAVING

Granolithic topping is to be in two layers to the total thickness shown on the Drawings and the topping shall consist of one part colored cement to two parts

aggregate shall be 70% black trap and remainder approved local colored stones.

Colours shall be as selected by the Architect.

Paving shall be rolled and trowel led to a dense even surface and rubbed down at completion, to a grit finished surface free from holes and blemishes.

The paving shall be laid in squares divided by plastic strips anchored securely in the screed and having their top edge truly level with the finished floor surface. The granolithic work shall be laid and polished complete to the approval of the Architect.

14.11.0 WOOD BLOCK FLOORING

Wood block flooring shall comply with the requirements of B.S. 1187 mentioned above and shall be dipped in a cold latex bitumen emulsion adhesive before laying. Any one package or bundle shall contain wood blocks of a single species, thickness, width, length and type of manufacture only. The pattern shall be approved by the Architect.

Wood parquet flooring shall comply with relevant standards and shall be laid using and approved adhesive in accordance with manufacturer's instructions.

14.12.0 P.V.C. COVERINGS

P.V.C. covering shall satisfy the Standard mentioned above and shall be obtained from an approved manufacturer's agent. Floor tiles shall be Dunlop or other equal and approved. Rates shall include for two or an approved emulsion floor polish or other protective coating.

14.13.0 GLAZED WALL TILES

Glazed wall tiles shall be cushion edged and satisfy the relevant Standard as mentioned earlier. Tiles shall be well soaked in water laid with straight horizontal and vertical joints painted in white cement and cleared down at completion.

Tiles joints of 2mm width shall be formed and filled with the redding mix but using very fine, well screened, care shall be taken that tiles are not over soaked and water shall be avoided during fixing.

The fixed tiles shall be kept damp for 4 days. Tiles as slash backs to lavatory basins, sinks and baths shall be fixed with necessary rounded-edge corner tiles.

Rates for linear items shall allow for all special fittings and cutting at angles and intersections.

14.14.0 GENERAL

Rates for in-situ work shall allow for raking out joints walling or hacking of treating with an approved bonding fluid. Hacking concrete form key, dubbing out irregular surfaces of base to provide a finished surface in the same plane as the surrounding surface, cutting out cracks, making good and leaving the whole of the work sound and perfect on completion.

Rates shall also allow for fair edges, whether square, splayed or rounded, arises, chamfered external angles not exceeding 25mm wide, rounded external angles not exceeding 25mm radius coved internal angles not exceeding 25mm radius, intersections to groins and the like, and for making good round pipe, brackets, floor spring boxes and all other items of a like nature.

Rates for all linear items shall allow for all short lengths, angles, end and arises, mitres and intersections and the like.

Rates for all paving shall allow for adequate covering protection during the progress of the works to ensure that the floors are handed over in perfect condition on completion.

Rates of external rendering shall allow for work at any height and for any scaffolding, ladders, cradles etc. required.

14.15.0 TERRAZZO PAVINGS:

Aggregate for terrazzo shall be good quality marble or other natural stone of similar characteristics, hard angular in shape, free from clay, iron oxide and other foreign matter, graded from 10mm to 6mm unless otherwise specified and without excessive content of fines or dust. The source of supply and the colour are to be approved by the Architect before bulk ordering.

Terrazzo flooring must be laid and finished by an approved specialist Sub-Contractor.

All base surfaces must be thoroughly cleaned to remove dust, dirt, rust, oil and loose material.

Terrazzo shall be laid in two courses as follows:-

a) Base course: cement-sand screed 1:3, not less than 20mm thick, followed immediately by

b) Topping terrazzo mix as specified, not less than 20mm finished thickness.

c) Skirtings are to be 6mm thick on a screed not less than 10mm thick.

Terrazzo bays shall not be more than 1M2 and joints shall be formed with plastic or aluminium strips set out to an approved pattern. Strips must be carried through the backings screed and finish flush with the floor surface.

Tamp lightly immediately after laying and compaction trowel lightly, taking care to avoid excessive laitance on the surface. Not less than 3 days after laying, rough polish by an approved mechanical means using water. Grout with a fine mix reserved from the initial mix. Not less than 8 days after grouting, fine polish by an approved mechanical means using water to a texture approved by the Architect.

11.16.0 TERRAZZO FLOOR TILES

Terrazzo floor tiles shall be B.S 4131 of approved manufacturer. The faces of tiles must be free from projections, depressions, flakes and crazes. The overall colour must be practically uniform in any one delivery. The facing level must not be less than 6mm thick after grinding.

Unless otherwise specified or approved by the Architect, tiles are to be 197mm x 197mm x 22mm.

14.17.0 MOSAIC FINISHES

Mosaic finishes shall comply with the requirements of B.S Codes of Practice C.P. 212 Part 2.

14.18.0 QUARRY TILE FINISHES:

Quarry tile finishes shall comply with the requirements of B.S. 1286

14.19.0 GRANITE:

Granite is to be sourced from an approved supplier.
Granite tiles (panels) shall be minimum 20mm thick and
Shall be cut straight and true to the pattern to be
Approved by the architect.

Granite tiles shall be laid on a suitable adhesive as
Recommended by the supplier.
All joints shall be filled with grout to match the granite colour
After laying and polished to provide a smooth even surface.

Exposed tile surfaces shall be bull nosed (or rounded and polished)

14.20.0 GRANITE / MARBLE WALL FINISHES

Granite and marble wall finishes shall be applied to areas as indicated on the drawings and no larger than can be safely fixed with an approved adhesive – i.e. no mechanical fixing and shall be minimum 8mm thick.

Granite shall be securely fixed, butt jointed, to form a smooth, even and vertical face.

Joints shall be pointed with a matching grout in accordance with the suppliers' recommendations.

Colours shall be carefully selected to match the approved shampoo colour

14.21.0 CERAMIC TILE PAVINGS AND ACCESSORIES

Ceramic tiles and accessories of the type described herein are to be fixed with an adhesive to comply with BF Code of Practice 202 : 1972 (" tile flooring and flab? Flooring"), tiles are to be laid with close straight joints in each direction
and upon completion grouted in matching coloured cement and washed and cleaned down.

Tiles are to be cut with an electric tile cutting saw.

14.22.0 PLASTERBOARD

The external plasterboard shall be to BS1230 and where described as insulating, shall have a bright aluminium foil model to one side.

Plasterboards shall be fixed on galvanized steel framework complete with all accessories and fixing. Beads shall be to BS6452.

Plasterboard shall be supplied complete with all jointing materials, including compounds and jointing tape to BS6214.

15.0 GLAZING

GLAZING

15.1. 0 STANDARDS AND CODES OF PRACTICE

The requirements of the following British Standards and Codes of Practice shall be observed.

British Standards

a) B.S 952 Glass for glazing.

b) B.S. 544 Linseed oil putty for use in wooden frames

c) **NOTE:** The Contractor's attention is drawn to Section "T" of the Standard Method of Measurements.

Codes of Practice

d) C.P. 152 Glazing and fixing glass for buildings.

15.2.0 MATERIALS AND WORKMANSHIP

The whole of the glass shall be of the best quality and be free from bubbles, specks, waves flaws or any other defects and shall comply with the requirements of the standard mentioned above.

All glass is to be accurately cut to fit easily into rebates. Glass shall be well puttied and sprigged with copper springs.

Glazing to wood frames shall be secured with glazing beads fixed with brass caps and screws and wash leather or approved "Neoprene" beading strips. Putty for lazing in wood frames shall be composed of pure linseed oil and powdered whiting, free from grittiness all in accordance with the standard mentioned above.

Glazing to metal frames shall be with clips, glass shall be properly back puttied and the front putty finished neatly and cleanly.

Putty for glazing in metal frames shall be quick hard setting tropical putty specially manufactured for use with steel windows.

Rebates of metal frames receiving glass shall be prepared and treated with primer for putty prior to glazing and putty shall be primed 10 days after glazing.

Rates for glazing Georgian wired glass shall include for aligning lines in adjoining panes both ways.

Glass panes shall be cut to sizes to fit the opening with not more than 1.6mm play all round. Clear sheet shall be ordinary glazing (OQ) quality and polished plate shall be (GG) quality.

Mirrors to be of selected glazing (S.G) quality plates glass of approved manufacture with beveled edge and fixed at all corners to walls with raw plugs and brass screws with removable chromium plated dome heads.

Cut out all cracked or broken glass re-glazed to match and leave perfect on completion. On no account shall windows be cleaned by scraping with glass.

15.3.0 PARTICULAR SPECIFICATIONS

15.3.1 GLAZING

15.3.1.1 Definitions

15.3.1.1.1 Fixings

The provision of glazing compounds and putties and sprigs, clips and other sundry fixings, shall be deemed to be included with all items of glazing.

15.3.1.1.2 Materials

15.3.1.1.2.1 Glass Generally

All glass shall comply in all respect with the appropriate section of B.S.952. Plain sheet clear glass shall be O.Q; plate glass shall be GG; all glass shall be as manufactured by Pilkington Brothers Limited or another approved manufacturer.

15.3.1.1.2.2 Putty for Glazing to Wood

Putty for glazing to wood shall comply with B.S.544.

15.3.1.1.2.2 Putty for Glazing to Metal

Putty for glazing to metal shall be approved mastic manufactured for the purpose, used in accordance with the manufacturer's instructions.

15.3.1.1.2.2 Samples

Samples not less than 150mm square are to be submitted to the Architect for approval before any glass is cut.

15.3.1.1.2 Workmanship

15.3.1.1.3.1 Glass to be kept free from moisture

All glass surfaces shall be kept dry during transit and storage. Glass becoming moist from condensation or other causes shall be thoroughly dried and aired.

15.3.1.1.3.1 Rebates and Beads

All rebates and beads in wood shall be primed, before glazing is commenced.

15.3.1.1.3.1 Edges of Glass

All glass shall have clean cut edges. All exposed edges (i.e. louvers) shall be rounded and polished.

15.3.1.1.3.1 Bead Glazing

Glazing fixed by beads shall have both glass and beads bedded and back puttied, and the putty trimmed off flush. Where sealing strip is used, it shall pass round both faces of the glass and be trimmed off flush on both sides. Metal surfaces to receive sealing strip shall be treated with mineral oil before glazing.

15.3.1.1.3.1 Putty Glazing

Glazing in putty shall be executed in proper bed and back putties, sprigs, clips and splayed and mitred front putties. The back putties shall be trimmed off flush with the top of rebate and the splayed front putties shall be finished 3 mm back from sight line to allow for sealing between glass and putty with paint.

15.3.1.1.3.1 Wired Glass

Wired glass shall in all cases be 6 mm Georgian wired, either polished or cast as specified. The wire in wired glass shall extend to the edges and be free from rust, and be parallel to the framing.

15.3.1.1.3.1 Mirrors

All mirrors shall be 6 mm polished plate, foil backed and with rounded polished edges. Mirrors with chips, cracks, scratches on back or front will not be accepted.

15.3.1.1.3.1 Safety Glass

All glass fixed below 900mm above floor level shall be either 6mm clear toughened or 6.5mm clear laminated, unless specified otherwise.

All other glass to doors and internal partitions shall be 6mm clear float glass.

Glass to existing windows shall match the original or adjacent glass.

15.3.1.1.3.1 Glass to Partitions

Glass to internal aluminium partitions shall be fixed in accordance with the approved partition system and as recommended by the supplier / manufacturer.

15.3.2 STRUCTURAL GLAZING

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Glazing should be Cool-Lite P: Pastel Blue tempered high performance glass by Saint Gobain and shall be:

a. 10mm thick.

b. Supplied complete with corresponding spandrel panels.

c. Supplied complete with floor to floor smoke / heat insulation.

d. Supplied complete with matching aluminium frames, opening and stay mechanism and completely watertight.

e. The wind exposure shall be based on the attached climatic data and a city center site.

f. Suitable for an internal air-conditioned environmental – ambient temperature – 23 degrees centigrade.

The structural glazing shall be supplied and installed by a specialist approved by the Architect and based on approved shop drawings.

STATION NAME : LOCAL MET. STATION
LATITUDE 0?20N LONGITUDE 32?36*E LATITUDE: 4304 FEET 1312 METRES

	ATMOSPHERIC		TEMP (60-95)		RELATIVE HUMIDITY			RAINFALL		DAILY		WIND SPEED		CALMS	
	PRESSURE (60-95)		MEANS		0300Z	0600Z	1200Z	MEAN	NUMBER	SUNSHINE		(1960-95)		(1960-95)	
MONTH	0600Z	1200Z	MAX	MIN	%	%	%	(1960-95)	OF RAIN	(1960-95)		0600Z	1200Z	0600Z	1200Z
	MB	MB	?C	?C				mm	DAYS	MAX MEAN	MIN.MEAN	KNOTS	KNOTS	DAYS	DAYS
JAN	870.1	867.3	28.4	18.1	53	78	53	51	6	9.2	5.4	7	12	2	0
FEB	869.9	867.3	28.3	18.1	84	80	55	62	7	9.2	3.7	6	13	2	1
MAR	869.8	867.3	27.5	18.0	91	82	60	113	11	8.0	5.0	7	12	1	0
APRIL	870.5	868.2	26.1	17.6	92	88	69	182	16	8.1	4.7	7	11	3	1
MAY	871.3	869.2	25.4	17.5	92	89	71	140	13	7.5	4.9	7	12	2	1
JUN	872.1	870.4	25.2	17.2	91	87	68	75	9	7.7	4.2	7	13	2	1
JUL	872.0	870.5	25.1	16.5	89	89	66	50	7	7.7	2.9	8	12	3	2
AUG	871.6	869.7	25.6	16.4	92	89	66	86	10	6.6	4.7	8	11	2	1
SEPT	871.3	868.9	26.6	16.6	93	87	65	101	11	8.0	3.5	8	11	2	1
OCT.	870.8	867.9	27.2	16.9	91	83	63	109	12	7.8	4.8	7	10	2	1
NOV.	870.3	867.4	27.2	17.3	86	81	61	114	11	7.9	5.1	6	10	2	1
DEC.	870.3	867.6	27.2	17.4	87	81	60	97	9	9.4	5.2	7	11	2	1

1 Knot = 1.85 km/hr

LONG/LAT 32.6 E/0.3N	MARCH	JUNE	SEPT.	DEC.
TIMES OF SUN RISE	6.52 A.M.	6.47 A.M.	6.39 A.M.	6.44 A.M
TIMES OF SUN SET	6.59 P.M.	6.59 P.M.	6.46 P.M.	6.51 P.M.

GLAZING

16.0 PAINTING AND DECORATING

16.0 PAINTING AND DECORATING

18.1.0 STANDARD AND CODES OF PRACTICE

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

British Standards

a)	B.S 2521 + 2523	Lead based joint
b)	B.S. 3968	Calcium plumbate priming paints
c)	B.S. 4756	Ready mixed aluminium priming paints for woodwork
d)	B.S. 1335	Knotting
e)	B.S. 3842	Treatment of plywood with preservatives.
f)	B.S. 4800	Paint colours for building purposes
g)	B.S 2524	Red-Oxide-Linseed oil priming paint
h)	B.S. 2525-7	Undercoating and finishing paints
i)	B.S. 1215	Oil Stains
j)	NOTE:	The Contractor's attention is drawn to Section "U" of the Standard Method of Measurements.

Codes of Practice

k)	C.P. 231	Paints for buildings
l)	C.P. 3012	Cleaning and preparations of metal surfaces.

16.2.0 GENERAL

All work under this trade must be executed by an approved specialist unless otherwise permitted.

The Contractor's Programme in this area shall be so arranged that all others trades are completed and away from the area to be painted prior to the commencement of painting. Before painting the Contractor must remove all concrete and mortar droppings and the like from all work to be decorated and remove all strains from and obtain uniform colour to work to be oiled and polished.

16.3.0 MATERIALS AND WORKMANSHIP

All plaster, metal, wood or other surfaces which are to receive finishes of paint, stain, polish, distemper or paint work of any description are to be carefully inspected by the Contractor before he allows any of his painters to commence work. The Contractor will be held solely responsible for all defective work as a result of his painter's failure to insist on receiving from the other trades surfaces in the proper condition to allow first class finishes to the various kinds specified being applied to them.

All painting and decorating schemes shall be carried out in colours selected by the Architects.

Paints shall be ready mixed, oil based priming paint shall comply with the requirements of the relevant standards mentioned earlier.

The oil shall comply with the requirements of B.S. 1215

All materials shall be of the best quality and shall be of an approved proprietary brand selected from the latest Schedule of Approved paints issued by the Ministry of Works.

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

Materials shall be delivered to site intact in the original sealed drums ortins and shall be mixed and applied strictly in accordance with the manufacturer's instructions and to the approval of the Architect.

Unless specifically instructed or approved by the Architect, no paints, distemper etc. are to be thinned or otherwise adulterated, but are to be used as supplied by the manufacturers and direct from the tins.

If required by the Architect the Contractor shall provide at his own expense samples of paints etc. with containers and cases to be forwarded, carriage paid, by the Contractor for analyzing to a laboratory.

The priming, undercoat and finishing coats shall each be of differing tints, and the priming and undercoats 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 Architect. Each coat must be approved by the Architect before the next coat is applied.

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 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 Architect before laying on, and such samples, when approved, shall become the standard for the works.

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 Architect.

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

Woodwork to be painted shall be rubbed down and all knots and resin pockets shall be scorched back and coated with knotting. After priming all nail holes and other imperfections shall be stopped and the whole surface be rubbed down and all dust brushed off. The surface of woodwork shall be lightly sand prepared between the coats.

All work in contract with walling or plaster shall be treated after cutting and preparation but before assembly or fixing with one coat of wood preservative. The solution is to be brushed on all faces of all timbers, unless exposed to view and painted. The Contractor shall not that this solution is poisonous and shall take all necessary precautions and instruct his workmen accordingly.

Wax polish shall be furniture polish of an approved branch, and wood surfaces shall be clean smooth free from oil or grease or any other blemishes. A minimum of two coats shall be applied to approval.

Plaster surfaces shall be perfectly smooth free from defects and ready for decorations. All such surfaces shall be allowed to dry a minimum period of six weeks, stopped with approved plaster compound stopping and rubbed down flush as necessary, and then thoroughly, immediately prior to decorating.

Plaster surfaces which are to be finished with emulsion, oil or enamel paint shall be primed with an alkali resisting primer complying with the particular paint manufacturer's specifications and applied in accordance with their instructions.

Fibre board or similar surfaces shall be lightly brushed down to remove all dirt, dist or loose particles and have all nail holes or other defects stopped with an approved plaster compound stopping rubbed down flush and left with a texture so match surrounding

materials and shall receive one coat petrifying liquid at last or two coats polyurethane or clear laquar.

All metal surfaces shall be thoroughly brushed down with wire brushes and scrapped where necessary to remove all scale, rust, etc. immediately prior to decorating.
Where severe rust exists and if approved by the Architect a proprietary de-rusting solution may be used in accordance with the manufacturer's instructions.

Hot primed and unprimed surfaces shall be given one coat of metal chromate primer.

Galvanized surfaces shall be treated before painting with an approved proprietary or de-greasing solution before priming.

Coated surfaces already treated with bituminous solution shall be scrapped to remove soft parts and then receive two isolating coats of aluminium primer or other approved anti-tar primer.

Existing painted and decorated surfaces shall be prepared as described above. Painted plaster, metal or wood surfaces shall then be rubbed down to expose the material beneath and old paint burnt off with blow torches if necessary in the Architect's opinion.

Emulsion paint on ceilings and all undercoats of emulsion paint and complete oil painting on walls shall be completed before PVC flooring are laid. Final coat of emulsion paints on walls shall be applied after such flooring has been laid complete.

Three coats of emulsion paints shall be applied to receiving surfaces using a thinning medium or water only if and as recommended by the manufacturer. An approved plaster primer tinted to match may be substituted for the first coat.

Enamel paint shall be applied in two undercoats and one finishing coat after preparation and priming as specified above.

All ironmongery shall be removed from joinery steel windows and louver before painting is commenced and shall be cleaned and renovated if necessary and re-fixed after completion of painting.

Rates for painting shall be deemed to include for preparing and priming surfaces above described.

Rates for paints, distemper etc. shall allow for covering up all floors, fittings, etc. with dust sheets when executing the work and for

removing, covering when no longer required and floor cleaning off, touching up and leaving perfect at completion.

17.0 DRAINAGE

17.0 DRAINAGE

17.1.0 STANDARD AND CODES OF PRACTICE

The requirements of the following British Standards and Codes of Practice shall be observed.

British Standards

a) B.S. 556 Part 1+2 — Concrete cylindrical pipes and fittings (including manholes, inspection chambers and street gullies)

b) B.S. 401 — Concrete un-reinforced tubes and fittings (with ogee joints for surface water drainage)

c) B.S. 437 Part 1 — Cast iron spigot and socket drain pipes and fittings.

d) B.S. 1247 — Manhole step irons (in malleable cast iron)

e) B.S 2760 — Pitch-impregnated fibre drainage pipes and fittings.

f) B.S. 1211 — Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.

g) B.S. 1130 — Cast iron drain fittings.

h) NOTE — The Contractor's attention is drawn to Section "V" of the Standard Method of Measurement.

Codes of Practice

i) C.P 301 — Building drainage
j) C.P. 2005 — Sewerage
k) C.P. 2010 — Pipelines

17.2.0 PLASTIC PIPES

The pipework and fittings for use underground shall be u PVC to B.S. 4660

17.3.0 CAST IRON PIPEWORK

Cast iron pipework which is used in connection with buried external services, shall be manufactured, coated and tested in accordance with the requirement of B.S. 1211

All buried cast iron bends, elbows sweep tees and other fittings, shall comply with the requirements of B.S. 1130.

Jointing on external cast iron pipe shall be carried out in accordance with one of the methods described in British Standards Code of Practice 301, Clause 505 c (v), to the approval of the Architect.

17.4.0 PITCH FIBRE PIPEWORK

Pitch fibre pipework and fittings for use in connection with external drainage services shall be manufactured in accordance with the requirements of B.S. 2760. Pipes shall be connected by means of purpose made tapered joints manufactured in accordance with B.S. 2760.

Until such time as the use of pitch impregnated fibre pipes is covered by Code of Practice, the jointing, laying and cutting of these pipes shall be carried out in accordance with the requirements of the notes under Appendix C of B.S. 2760.

17.5.0 CONCRETE PIPEWORK

Where concrete pipes and fittings are used in connection with the conveyance of surface water or sewage under atmospheric pressure, they shall be manufactured in accordance with the requirements of B.S. 556, Class 1, except where otherwise stated.

The joints of concrete pipe and fittings may be one of the following depending upon application and conditions:-

1) Flexible spigot and socket type
2) Flexible rebated type (stormwater drainage only)
3) Ordinary spigot and socket type.
4) Ordinary rebated type (Stormwater drainage only)

Joints (1) and (2) shall be sealed with suitable rubber gaskets manufactured in accordance with B.S. 2494 except where they are likely to be contaminated by oil products, in which case the gaskets shall be manufactured in accordance with B.S. 3514.

Joints (3) and (4) shall be made with approved cement mortar mix.

17.6.0 ASBESTOS CEMENT SOIL WASTE AND VENTILATION PIPES

Where spigot and socket asbestos cement pipes and fittings are used in connection with the conveyance of soil and waste or ventilating purposes in above ground applications, they shall be manufactured in accordance with B.S. 583 and shall comply with Uganda Environment requirements.

Pipes and fittings shall be joined with cement/sand mortar cement content not to be greater than 30% of the fibrough cementations jointing compound.

Alternatively, if synthetic rubber rings are used, the annular space between socket and pipe above the ring shall be packed with a suitable mastic compound.

Rubber rings shall comply fully with the requirements of B.S. 2494.

17.7.0 VALVES

17.7.1 DRAW-OFFS AND STOP VALVES (UP TO 50MM NOMINAL BORE)

Draw off taps and stop valves up to 50mm. Nominal bore, unless otherwise stated or specified, for attachment or connection to sanitary fitments shall be manufactured in accordance with the requirements of B.S. 1010.

17.7.2 GATE VALVES

All gate valves 80mm. Nominal bore and above, other than those required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of B.S. 3464.

All gate valves required for fitting to buried water mains shall be of cast iron construction in accordance with the requirement of B.S. 1952.

All gate valves up to and including 65mm. Nominal bore shall be of bronze construction in accordance with the requirements of B.S. 1952.

The pressure classification of all gate valves shall depend upon the pressure conditions pertaining to the Site Works.

17.7.3 GLOBE VALVES

All globe valves up to end and including 65mm. Nominal bore shall be of bronze construction in accordance with B.S. 2060.

All globe valves 80mm. Nominal bore and above shall be of cast iron construction in accordance with the requirements of B.S. 3961.

The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the Site of Works.

17.7.4 CHECK OR NON-RETURN VALVES

All check or non-return valves up to and including 65mm. Nominal bore shall be of the swing check of bronze construction in accordance with B.S. 1953.

All check or non-return valves 80mm. Nominal bore and above shall be of the swing check type of cast iron construction in accordance with the requirements of B.S. 4090.

The pressure classification of all check-non-return valves shall depend on the pressure conditions pertaining of Site of the Works.

17.7.5 BALL VALVES

All ball valves for use in connection with hot and cold water services shall be of the Portsmouth type in accordance with the requirements of B.S. 1212, constructed from bronze or other corrosion resistant materials. These valves fall into three pressure classification as follows:-

(a)	Low Pressure	-	3,538 b maximum
(b)	Medium Pressure	-	7,725 b maximum
(c)	High Pressure	-	12,620 b maximum

The pressure classification required for each ball valve will be designated in the description of its associated equipment contained in Part C of the Specification.

17.7.6 MANUALLY OPERATED MIXING VALVES

Mixing valves for shower fittings and other applications being provided under the Sub-Contract Works shall be manufactured in accordance with the requirements of B.S. 1415 from bronze or other corrosion resistant materials.

17.8.0 WASTE FITMENT TRAPS

19.8.1 STANDARD AND DEEP SEAL P AND S TRAPS

Where standard or deep seal traps are specified they shall be manufactured in suitable non-ferrous materials in accordance with the full requirements of B.S. 1184.

In certain circumstances, cast iron traps may be required for cast iron baths and in these instances bath traps shall be provided which are manufactured in accordance with the full requirements of B.S. 1291.

17.8.2 ANTI-SYPHON TRAPS

Where anti-syphon traps are specified, these shall be similar or equal to the range of traps manufactured by Greenwood and Hughes Ltd., Deacon Works, Littlehampton, Sussex, England.

17.9.0 GENERAL

Drain pipes have been measured over all bends, junctions and other fittings and the Contractor shall include in his prices for all joints, short lengths, cutting and waste. Rates for bends, junctions, etc., shall include for the extra joints, cutting and waste and any labour required.

Lines of drains shall be accurately set out and trenches excavated and bottom trimmed to accurate gradients to approval before pipe laying commences.

Generally the drainage is to be executed in suitable sections to cause the minimum interference to the continual use of any existing drains. The location and depths of any existing drains shall be ascertained before other work is commenced and the rates are to include for all costs of complying with this requirement.

Excavation for drain trenches shall be not less than 300mm wider than the external diameter of the pipes and rates shall include for grading ground under beds, carefully filling earth to avoid damaging pipes, ramming and carting away surplus excavated material, keeping excavations free from water, if necessary executing such works and installing such pumps as may be

required to keep the excavations dry at all times, and any necessary planking and strutting.

No subsoil water shall be discharged into the sewers without the written permission of the Architect.

Excavations shall be made to such depths and dimensions as may be required by the Architect to obtain proper falls and firm foundations. No permanent construction shall be commenced on any bottom until the excavation has been examined and approved by the Architect. Should the Contractor in error or without the instruction of the Architect, make any excavation below the required level of the drain or bed, as the case be, he will be required to refill such excavation to the correct levels with concrete (1:4:8 – 38mm gauge).

Rates shall include for excavating in all materials met with and for trimming bottoms to the necessary falls and working space.

The first back filling of pipes trenches is to be of material free from stone and shall be watered and carefully tamped over and around the pipes in 300mm layers until they are covered to a depth of 600mm. Subsequent filling is to be in 150mm layers watered and rammed, only, materials approved by the Architect are to be used for backfilling.

Where hardcore is used for backfilling it is not to exceed 150mm gauge and all interstices shall be properly filled with small pieces and fine binder. Surplus excavated materials are to be removed from site.

If in the opinion of the Architect care has not been exercised in refilling trenches, he may order a fresh test to be on the drain. In the event of the drain failing to pass the test the contractor will be required to remedy the fault at his expense.

Concrete beds and surrounds shall be of concrete 1:3:6 – 20mm gauge to the thickness falls, and widths specified. Hollows shall be left to receive the collar of the pipe, so that the pipes sufficiently wide to form hard-holds to permit the joining of pipe, and after resting drains shall be haunched to both sides to half the diameter of the pipe in similar concrete.

Where pipes are specified to the surrounds, the concrete shall be carried up from the bed in a square section with a minimum of 150mm in thickness over the barrel of the pipe.

Rates for beds and surrounds shall include for forming recesses and filling with concrete, for mortar layer etc. and for any necessary formwork.

Each pipe shall be carefully examined on arrival, any defective pipes shall be removed immediately from the site and not used in the works. Minor damage to the protective coating of cast iron pipes shall be made good by painting with hot tar; if major defects in the coating exists such pipes shall be rejected and removed form the site.

Drains are to be laid in a straight line from point to point and each pipe is to be properly bowed in so that the invert is a true and even gradient in order to achieve a fall giving a self cleansing velocity. The Contractor shall provide suitable equipment and set up and maintain all sight rails, bowing rods, and bench marks etc. necessary for the purpose.

All drains shall be kept free from earth debris, superfluous cement and other obstructions or water during laying and until completion of the contract when they shall be handed over in a clean condition.

Pipes shall be laid with sockets leading uphill and shall rest on solid and even foundations for the full lengths for the barrel, sockets recesses shall be formed in the foundations, as short as practicable but sufficiently deep to allow the pipe jointer room to work right round the pipe. Such recesses shall be filled with cement mortar (1:4) on completion of laying.

All joints are to be accurately made by butting the pipes together, caulking with tarred rope neat cement finished externally with bold fillet neatly pointed. As each pipe is laid it is to be drawn with a badger and left free of all obstructions.

Rates of bends junctions and other fittings in drains shall include all cutting and waste and extra joints.

The testing of drains shall be done at completion and before the trenches are filled in. They shall be tested in the presence of the Architect and a representative of the Local Authority by filling with water having a head not less than 1.5m at the highest point of the section under test. A second and similar test may be applied, after the drain trenches are filled in and the work complete.

Manholes shall be construction in the position indicated on the Drawings or as required by the Architect. Such chambers shall be to the depths required to obtain even gradients in the drain and of sufficient size to contain the requisite main channel and any branches thereto and all the entire satisfaction of the Architect and Local Authority.

Rendering to manholes shall be trowelled smooth coved at all internal angles and rounded at arises.

Manholes are to be tested for water-tightness in the same way as to drain by filling with water but not exceeding 1.5m head. The Contractor shall supply all testing apparatus and materials necessary for these tests and provide all labour and assistance required. Any failure whatsoever in the drainage system to withstand the specific tests and any defects appearing are to be made good and the drains re-tested to the satisfaction of the Architect and Local Authority.

For connection to public drainage the Contractor shall make all arrangements with the Local Authority and pay all fees that may be required for connections to main sewers.

17.10.0 TESTING AND INSPECTION

Site Tests – Pipework System

17.11.0 UNDERGROUND DRAINAGE SYSTEM

A Site test shall be carried out on all drainage pipes before concrete haunchings or surrounds are applied. These tests shall be carried out preferably from manhole to manhole.

Short drains connected to a main drain between manhole shall be tested as one system with the main drain. In long branches a testing junction shall be inserted next to the junction with the main drain and the branch tested separately. After the test has been passed, the testing junction shall be effectively sealed.

All test on underground drains shall be water tests. Smoke tests shall not be permitted.

In certain circumstances air tests may be permitted on cast iron drains at the discretion and to the approval of the Architect.

Water tests shall be carried out in accordance with the methods described under B.S. Code of Practice 301. Clauses 601 (b) and (c) and the test pressure shall be not less than 1.520mm head at the highest point in the pipe section and not more than 10.360m head at any point in the section.

The test pressure shall be maintained for a period of one hour during which time the pipes and joints shall be inspected for sweating and leakage. Any leaks discovered during the tests shall be made good by the Sub-Contractor and the section re-tested.

In addition to pressure tests, drain pipe runs shall also be tested for straightness where applicable. This test shall be carried out in

accordance with one of the two methods described in B.S. Code of Practice 301, Clause 601 (C).

Testing of manholes shall be carried out in accordance with the methods described under B.S. Code of Practice 301, Clause 601 (f).

17.12.0 ABOVE GROUND SOIL WASTE AND VENTILATION PIPE SYSTEMS

All soil, waste and ventilation pipe system forming part of the above ground installation, shall be given a smoke test to a pressure of 38mm of water gauge and this pressure shall remain constant for a period of not less than three minutes.

All soil, waste and ventilation pipe system forming part of the above ground installation, shall be given a smoke test to a pressure of 38mm of water gauge and this pressure shall remain constant for a period of not les than three minutes.

Water tests on above ground soil, waste and ventilating pipe systems shall not be permitted.

Pressure tests shall be carried out before any work which is to be concealed is finally enclosed.

Any defects revealed by the tests shall be made good by the Sub-Contractor and the test repeated to the approval of the Architect.

In all other respects, tests shall comply with the requirements of B.S. Codes of Practice 304.

17.13.0 SITE TEST – PERFORMANCE

Following satisfactory pressure tests on the pipework systems, operational tests shall be carried out in accordance with the relevant B.S. Codes of Practice on the system as a whole to establish that special valves, gauges, controls, fittings equipment and plant are functioning correctly to the satisfaction of the Architect.

18.0 EXTERNAL WORKS

18.0 EXTERNAL WORKS

18.1.0 STANDARDS

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

British Standards

a). B.S. 1621 Bitumen Macadam (with crushed rock or slag aggregate)

b). B.S. 340 Precast concrete kerbs, channels, edgings and quadrants

c) B.S. 368 Precast concrete flags

d) B.S. 4428 General landscape operations (excluding hard surfaces)

e) B.S. 3882 Recommendations and classifications for top soil

f) B.S. 3936 Nursery stock

g) B.S. 3998 Recommendations of treework

h) NOTE Preambles to precending trades where applicable shall apply equally to the work contained herein.

18.2.0 GENERALLY

20.2.1 Standard specification

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

20.2.2 Submission of samples

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

conform, within the specified tolerances, to the quality of approved samples.

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

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

All materials delivered to site must be at least equal in all respects to approved samples.

18.2.3 Manufacturer's Certificates

The Contractor shall, whenever required obtain from the manufacturer and submit to the Architect, certificates showing that tests of materials have been carried out in accordance with the requirements of the relevant British Standards, or other approved Standards, or with the requirements of this Specification.

No payment will be made in respect of any costs incurred by the Contractor or by the manufacturers in connection with tests required by this clause or for supplying test certificates in respect thereof.

18.2.4 Rejected materials

Should any materials or articles manufactured on or off the site be, in the of the judgement Architect, of inferior quality, or damaged in any way as to make it unsuited for the work, then such materials or articles shall not be used on the works and shall be removed and replaced, all at the Contractor's expense and in each case as the Architect shall decide and direct.

18.2.5 Building stone

All building stone shall be capable of withstanding when wet a crushing stress of 1.4kg/sq.mm. The source shall be approved by the Architect and stone supplied there shall be free from magadi,overburden, mudstone, cracks sandholes, veins laminations or other imperfections. The stone shall be chisel-dressed into true rectangular blocks, with each surface even and at right angles to all adjoining surfaces, to the size specified. For exposed stonework the maximum permissible variation of any of the specified dimensions shall be 6mm provided that cut stone, supplied as rock face stone may be hammer dressed on one face only, or on the face and one end, if in other respects it

conforms with this specification. Stone shorter than 75mm will not be accepted.

Unless the Architect allows otherwise the Contractor shall at his own expense provide and dress for 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with B.S. 1438: madia for Biological percolating filters, Appendix B, (sodium sulphate soundness test) except that:

a). The treatment shall be repeated for 10 cycles only ; and

b). The second criterion of failure shall be amended to allow for a loss of weight of not more than 20% of its original weight.

18.2.6 Stone dust

Stone dust for blinding shall be blacktrap screened to the following grading:-

a).	Passing	10mm sieve	100%	
b)	Passing	No. 4 sieve		85% - 100%
c)	Passing	No. 100 sieve	5% -	25%

18.3.0 SITE CLEARANCE AND EARTHWORKS

20.3.1 Levels to be agreed in advance

Prior to any site clearance, the Contractor shall satisfy himself that the existing ground levels as indicated on the Drawings or schedules of longitudinal or cross section levels are correct. Should the Contractor wish to dispute any levels he shall submit to the Architect a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the Architect's decision as to the correct levels is given. If the Contractor fails to take the requisite levels, the ground levels shown on the Drawings and sections or as determined by the Architect shall be taken as correct.

18.3.2 Clearing

Prior to commencement of any earthworks, the Contractor shall clear the area of the Site indicated on the Drawings, unless otherwise directed by the Architect. He

shall also, at times required or approved by the Architect, clear the site over the area of stockpiles, road junctions, lines of ditches or drains and such areas as the Architect may require.

All surface objects and all trees, hedges, scrub, undergrowth, stumps and tree roots,
not designated to remain, shall be cleared and/or grubbed.

Materials and debris which cannot be burnt shall be carted to tips provided by the Contractor or otherwise disposed of to the satisfaction of the Architect.

18.3.3 Removal of topsoil roots and grass

Topsoil, roots and grass shall be stripped in a separate operation from clearing.

Unless otherwise directed by the Architect, topsoil, roots and grass shall not be stripped over the full area of the site, but only over the area affected by the earthworks.

18.3.4 Dust

The Contractor shall implement measures to control dust, by periodically spraying the works with water.

The Contractor shall take all necessary precautions against the growth on the site of weeds and shall remove them as necessary throughout the period of works and maintenance.

18.3.5 Earthworks limits

The Contractor shall restrict his workings to the limits described in the Contract, unless otherwise approved by the Architect.

18.3.6 Definitions

Fill-material	:	"Fill-material" shall mean material deposited in accordance specifications from any of the classes specified in clause W.9 in order to build up an earthworks construction to formation level as shown on the Drawings or as ordered by the Architect.

Spoil-material	:	"Spoil-material" shall mean material deposited in accordance with these specifications from any of the classes specified in clause W.9 and which, being obtained from "cut" is unsuitable surplus to the requirements of the works.
Sub-grade	:	"Sub-grade" shall mean the upper layer(s) of material, either insitu or infill. Where there is no improved sub-grade, the top of the sub-grade is at formation level. When an improved sub-grade is placed, the top of the improved sub-grade is then considered as the formation level. In this section, unless otherwise specified, "sub-grade" shall mean the upper 300mm of earthworks (compacted thickness), either in-situ or infill.
Improved sub- grade	:	"Improved sub-grade" shall mean the layer(s) of selected infill material, the top of which is at formation level, placed where the natural in-situ or fill-material is, in the opinion of the Architect, unsuitable for the direct support of the pavement. The material for sub-grade shall be obtained from borrow areas. The thickness of an improved sub-grade shall be at least 150mm.

18.3.7 Classification of excavated material

Excavation will be paid for separately for the following three classes of material:-

a). Class 1 : Hard material (or rock) : This class shall include all material which, in the opinion of the Architect, either:-

i) requires blasting for its removal or,
ii) requires the use of metal wedges and sledge hammers for its removal, or
iii) requires the use of compressed air drilling for its removal or,
iv) is such that, when worked with a tractor of at least 200kw (270 flywheel h.p.), fitted with a rearmounted heavy-duty hydraulic single tune of 100mm maximum width, the tine penetrates to a depth less than 75mm.

b). Individual boulder greater than 1C.M. in volume shall be included in this class when their nature and size are such that, in the opinion of the Architect they cannot be removed without recourse to one of the above methods.

c). Where a portion of excavation contains 50% or more by volume of boulders of this order, such portion shall be considered as class 1 material throughout.

d) Class 11 :Medium-hard material (or rippable) : This class shall include all material such as consolidated gravel, weathered or stratified rock, stones or boulders less than 1 C.M. in volume, which, in the opinion of the Architect:-

i). Can be extracted without recourse to the methods specified for class 1 material, but

ii). requires ripping for its removal, or
iii). in confined spaces, requires hand-excavation using compressor tools for its removal.

e) Provided all reasonable steps have been take to the satisfaction of the Architect, to facilitate the removal of the material by other methods.

f) Class 111: Normal Material: This class shall include all material which does not require recourse to the methods for class 1 and 11 materials.

18.3.8 <u>Excavation</u>

Over excavation: Any excess excavation shall be made good at the Contractor's own expense by backfilling with approved "base" material, deposited and compacted as specified.

Where slopes in rock are excavated in excess the tolerance specified shall be reinstated in class 25 reinforced concrete all suitably bolted to the rock face as directed by the Architect at the Contractor's own expense.

Excavation below embarkments and below formation level: where any material below the natural ground level under embarkments or below formation level in cuttings is required to be excavated, it shall be removed to such depth and over such areas as shown on the Drawings or as directed by the Architect. The resultant excavation shall be backfilled with an approved material deposited and compacted as specified for the forming of embarkments and sub-grade.

If, after the removal of material as specified in the above paragraph, the Contractor allows the material exposed to reach a condition where compaction of back-filling is impracticable, he shall make good at his own expense, either by additional excavation and backfilling or by other measures.

18.3.9 <u>Stockpile areas</u>

The Contractor shall obtain the approval of the Architect to the sitting of the stockpiling areas.

No material shall be stockpiled without the consent of the Architect. The Contractor shall give the Architect at least 24 hours notice of his intention to stockpile. Stockpile areas shall be chosen and prepared and all stockpile material shall be deposited in such a way as to facilitate subsequent measurement of stockpile volume and in all instances shall be to the satisfaction of the Architect.

18.3.10 <u>Construction of embankments and fills</u>

General: All embankments and fills shall be formed and completed to the correct lines, slopes, widths and levels shown on the Drawings.

Where shown on the Drawings or directed by the Architect, shoulders and beam shall be constructed as part of the earthworks operation and paid for as such.

Unless otherwise specified, where an embankment of less than 1m below formation level is to be made, topsoil and all vegetable matter shall be removed from the surface upon which the embankment is to be placed and the cleared surface shall be completely broken up by ploughing or scarifying to a minimum depth of 150mm. This area shall then be compacted to a dry density of at least 95% MDD (Standard Compaction).

Unsuitable material: Embankments and fills shall be constructed only of material approved by the Architect, obtained from the excavations of cuttings, ditches and borrow-areas.

Materials with high swelling characteristics or high organic matter content and any other undesirable material shall not be used, unless specifically directed by the Architect. Unsuitable material shall include:-

a). All material containing more than 5% by weight, of organic matter (such as topsoil, material from swamps, peat, loggs, stumps and perishable material).

b) All material with a swell of more than 3% (such as black cotton soil).

c) All clay of liquid limit exceeding 80 or plasticity index exceeding 50.

d) Materials having moisture content greater than the maximum permitted for such materials.

18.3.11 **Rock-fill:** "Rock-fill" shall consist predominantly of class 1 material of such size that the material can be placed only in layers of compacted thickness exceeding 300mm.

Unless otherwise directed by the Architect, stones and boulders greater than 0.2 C.M. in volume (average size : 600mm) shall not be used for the construction of embankments and fills.

Selection of materials for the upper layers : The Architect may direct the certain materials to be excluded from the sub-grade (see clause W.15) or from the upper layers of fill. He may also direct that other materials be set apart or obtained from borrow and used only for these layers. The Contractor shall then comply with the Architect's directions and shall allow in his rates for such selection of materials.

Rock-fill shall not be placed less than 600mm below formation level.

18.3.12 **Laying of Compaction:** Where material other rock-fill is used for the construction of embankments and fills, it shall be placed in layers of compacted thickness not exceeding 300mm, unless otherwise directed by the Architect. The layers shall be parallel to the top of sub-grade level and cross-section.

Unless otherwise specified, the layers of fill material shall be compacted throughout to a dry density of at least 95% MDD (Standard Compaction), except for the upper 300mm (sub-grade) which shall be compacted to a dry density of at least 100% MDD (Standard Compaction).

The moisture contents of the material shall be adjusted so that the above minimum compactions are obtained. Unless otherwise accepted by the Architect, the moisture contents at the time of compaction shall not exceed 105% of the optimum moisture content (Standard Compaction). Where water needs to be added, it shall be applied in an even manner and the rate of application shall be such that no transverse or longitudinal flow occurs.

Where rock is used a filling, the rock shall be placed in the bottom of the embankment or as directed by the Architect. The largest portions of rock shall be placed in layers of maximum compacted thickness of 1m. The interstices shall be filled with spalls and finer material approved by the Architect. The whole layer shall be material approved method, until the interstices are completely filled and until the specified compaction is obtained.

18.3.13 **Drainage of works**

All cuttings and embankments shall be kept free of standing water and drained during the whole of the construction.

Should water accumulate on any part of the earthwork either during construction or after construction the Contractor shall remove and replace at his own expense any material, which in the opinion of the Architect, has been adversely affected.

The Contractor shall so order his construction programme that the construction of culverts and drains does not lag behind the earthworks. Well in advance of commencing the earth-moving operations over swampy or waterlogged areas, the Contractor shall cut drains and ditches and carry out any other works as necessary to assist in draining the ground.

All drains and ditches shall be maintained in proper working order throughout the duration of the Contract.

The Contractor shall allow in his rates for draining the earthworks satisfactorily at all stages during the construction and arrange his methods and order of working accordingly.

He shall provide within the site where necessary temporary water-courses, ditches drains, pumping or other means of maintaining the earthworks free from standing water. Water discharged from the site shall not be run into a road but be carried direct to an approved sewer, ditch or river through troughs, shutes or pipes.

Such provision shall include carrying out the work of forming the cuttings and embankments in such a manner that their surfaces have at all times a sufficient minimum crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

In pumping out excavations and in any lowering of the water table the Contractor shall pay due regard to the stability of all structures.

18.3.14 <u>Side ditches</u>

Side ditches, considered as earthworks and measured and paid for as such, shall be shaped by excavating to the lines, slope and widths shown upon the Drawings and finished off so that the sub-grade levels and Camber or super-elevation of the of the sub-grade level and cross fall of the shoulders and slope and invert levels of the side ditches are everywhere in accordance with the Drawings or as directed by the Architect.

18.3.15 <u>Sub-grade and improved sub-grade</u>

Unless otherwise specified or directed by the Architect, materials forming the direct support of the pavement shall comply with the following requirements:-

a) CBR (100% BS - 4 days soak) : Minimum 5%

b) Swell (100% BS - 4 days soak) : Maximum 2%

c) Organic matter (percentage by weight : maximum 3%

Where, in the opinion of the Engineer, material unsuitable for the direct support of the pavement occurs in cuttings, the Contractor shall excavate it to the depths and widths directed and replace it with selected fill material to form an improved subgrade. The work will be paid for at the appropriate rates of "spoil" and "fill" and no additional payment will be made.

18.3.16 Laying and compaction:

The maximum compacted thickness which shall be laid, processed and compacted at one time shall be 300mm.

The layer shall be clarified, water shall be uniformly mixed in or the material allowed to dry out to the correct moisture content.

The upper 300mm of the earthworks (that is to the sub grade) shall be compacted to a dry density of at least 100% MDD (Standard Compaction) in cuttings where there is no improved sub grade and everywhere in fills and embankments.

In cuttings where an improved subgrade is to be placed, the upper 150mm of the subgrade prior to the placing of the improved subgrade layer(s), shall be compacted to at least 100% MDD (Standard Compaction), unless otherwise specified.

All improved subgrade shall be compacted to a dry density at least 100% MDD (Standard Compaction) for its full depth.

The moisture content shall be adjusted in order that the above minimum Compactions are obtained. Unless otherwise accepted by the Engineer, the moisture content at the time of compaction shall not exceed 105% of the optimum Moisture Content (BS).

Top of subgrade (including improved subgrade) : During the above process, the surface of each subgrade layer shall be graded to level, parallel to the crossfall and camber and profile shown upon the Drawings or directed by the Engineer and to the Tolerance specified.

The subgrade shall be cleaned of all foreign matter and way potholes, loose material ruts, corrugations, depressions or other defects which have appeared in the

subgrade layer, due to improper drainage, traffic or any other cause, shall be corrected. If directed by the Engineer, the Contractor shall scarify, grade and recompact the subgrade to line, level and specification at his expense.

No work above the subgrade shall be executed until the subgrade has been inspection and approved by the Engineer.

18.4.0 CONSTRUCTION OF SUB-BASE AND BASES

18.4.1 General

The term "gravel" used throughout this section shall be deemed to include; lateritic gravel, Quartizitic gravel, some forms of weathered rock, soft stone, coral rag and conglomerate.

A "grade" base will be made up of one of these natural gravels, or of sand or clay sand, or of a combination of these materials, without the addition of any stabilizing agent.

18.4.2 Material requirements

Unless otherwise specified or directed by the Engineer, the material shall comply with the following requirements:-

California bearing ratio:

a). The material for base shall have CBR of least 80.

b). The material for sub-base shall have a CBR of at least 30.

c) Unless otherwise specified, the CBR shall be measured at a dry density corresponding to 95% MDD (heavy compaction) and after 4 days.

18.4.3 Requirements for gravel:

In addition to the CBR requirements, the gravel material shall comply with the following specification:-

Gravel for		Base	Sub-base
Plasticity Index	- Maximum	15	25
Loss Angels value	- Maximum	30	70

Aggregate Crushing value - 75	Maximum	35

Grading:

The grading curve of the material, after processing compaction shall be a smooth curve within either of the following envelopes, as applicable:-

Sieve Size (mm)	Percentage by weight passing					
	Base			Sub-grade		
80	-			100		
63	-			95	-	100
50	100			90	-	100
40	95	-	100	85	-	100
28	80	-	100	72	-	100
20	60	-	100	55	-	100
10	35	-	90	30	-	100
5	20	-	75	18	-	85
2	12	-	50	10	-	65
1	10	-	40	8	-	52
0.425	7	-	33	7	-	43
0.075	4	-	20	4	-	35

Clayey Sand:

In addition to the CBR requirement, the clayey sand for sub-base shall comply with the following specification:-

Percentage passing 2mm Sieve: Maximum 95

Percentage passing 0.075 mm Sieve : Maximum 10 - Maximum 30

Uniformity coefficient: Minimum 5

Plasticity Index Minimum 5- Maximum 20

18.4.4 Setting Out Sub-base to line and level

The Contractor shall set out the road line and level at intervals of not more than 25 metres or such lesser intervals on horizontal and vertical curves as the Engineer may require, and sufficient to ensure that the levels of the sub-base are constructed within the specified tolerances and the minimum thickness ordered for the course. Reference

pegs shall be provided clear off the road and at right angles to it from which the centre-line or level can be re-established at any time. These shall be maintained so long as they are needed by the Engineer to check the work.

All setting out shall be agreed by the Engineer before any sub-clause or base course work is commenced.

18.4.5 Laying and compacting natural material sub-base and base

The sub-base and base material shall be deposited in such quantity and spread in a uniform layer across the full width required, so that the final compacted thickness is nowhere less than shown upon the Drawings or ordered by the Engineer.

The compacted thickness of any layer laid, processed and compacted at one time shall not exceed 200mm and where a greater compacted thickness is required, the material shall be laid and processed in two or more layers.

The material shall be broken down so that the maximum size of any particle is not greater than specified. This may require a grid-cleator sheep-foot roller or a pulverizer and the Contractor shall allow for such processing in his rates.

Any oversize material which cannot be broken down to the required size shall be removed and disposed of as directed by the Engineer.

The layer shall then be scarified and water shall be uniformly mixed in, as directed by the Engineer. It shall be graded, Compacted to a dry density of at least 95% MDD (Heavy Compacted) and graded to final level.

The moisture content shall be adjusted so that the above minimum Compaction is obtained. Unless otherwise directed by the Engineer, the moisture content at the time of compaction shall be between 80 and 105% of the optimum Moisture Content (Heavy Compaction).

18.4.6 Tolerances

The Sub-base and base shall be constructed within the tolerance specified.

18.4.7 Surface levels of flexible pavement course and concrete pavement

The level of any point on the surface of each of the pavement course of the carriageway, the true level as specified, shall on completion of compaction, conform to that shown on the Drawings within the tolerances stated in column 3 of the following table.

Compliance with the requirement shall be checked, in respect of the surface of each course, either by levelling in relation to a survey Datum using pegs or pins, or if raised or flush kerbs or concrete marginal haunches, concrete form, rails or bankettes have been laid, by use of a template or stretched line, using a datum the top surface of the levelling device after the profile or level of the latter have been approved by the Engineer.All longitudinal profile devices shall be laid true to line and level each within a tolerance of +/- 3mm the tolerance in level being measured over 8 metres. If this tolerance is exceeded the level and alignment shall be corrected, if necessary, by lifting and relaying or resetting.

In case of the base course and wearing course of flexible surfacing, and the surface of concrete pavements, the finished surface, in addition to conforming to the limits of tolerance from the true surface levels as specified above, shall when tested with a 3 metre straight edge placed parallel to the center line of the road, have no depression greater than the appropriate one stated in the following table:-

Measurements of level of tolerances shall be made while the material is still warm and rectification where necessary, carried out immediately; otherwise the Engineer may require the whole area involved to be removed to the full depth of the layer and reconstructed with fresh material.

Surface	Tolerance from true surface level	Maximum Depression tested with 3m straight edge placed on the surface parallel to the center line of carriageway
Sub-grade	+0-50mm	-

18.5.0 DRIVE WAYS AND PARKING AREAS

20.5.1 Excavations

Excavations to areas to receive bitumen macadam or other road or paved finish shall be carried out in a manner ensuring that excavations plant and vehicles do not cause shear failure more than 250mm in the sub-grade. Wheel loads and tyre pressures shall be limited and work shall be interruption to let the sub-grade dry out as necessary to avoid such
sub-grade failure.

If shear failure more than 250mm deep occurs in the sub-grade, the soil affected shall be excavated and replaced by soil filling as described.

If the soil develops highly elastic conditions as excavation approaches formation level, excavations shall be interrupted until the excess pore consequently disappears.

Before any further work is executed the formation level must be inspected and approved by the Engineer.

18.5.2 Compaction

The sub-grade shall be compacted by a smooth-wheeled roller of 8 to 10 tonnes weight or vibrating roller of minimum 1,300kg., or other approved plant. The number of coverages shall be at least 10 and there shall be a 50% overlap of successive coverages. If so instructed by the Engineer, water shall be added during compaction to obtain optimum water content. Filling shall be compacted as above but in maximum 200mm deep layers.

18.5.3 Sub-grade surface finish

The surface of the sub-grade shall be finished to the levels, falls and crossfalls shown on the Drawings within the following tolerances:-

i). The level shall not be above and not more than 50mm below the level shown on the Drawings.

ii). The falls shall be within 10% of the falls shown on the Drawings.

iii). The smoothness shall be such that departures from a 3 metre straight edge laid in any direction shall not exceed 50mm and there shall be no ponding of water.

18.5.4 Coarse Aggregate

Coarse aggregate for the base shall be crushed stone or rock confirming to the following requirements:-

18.5.5 Sub-base

The material for use in the sub-base shall consist of crusher dust as described, or other approved material. It shall be placed in one layer of such thickness that when compacted it shall attain the finished thickness shown on the Drawings. The material shall be watered as necessary and compacted as described. The sub-base material shall have a CBR value (unsoaked) for not less than 25.

18.5.6 Base

The material for use in the basecourse shall consist of one layer of course aggregate as described of which the interstices are filled with fine material consisting either of crusher dust or a mixture of crusher fines. The proportions of crusher dust and crusher fines in the fine material shall be such as to obtain the maximum density of base course when compacted.

The procedure for construction shall be as follows: The course aggregate shall be placed in a layer of such thickness so as to obtain the required thickness after compaction. It shall then be compacted lightly until the Engineer is satisfied that a layer true to shape and level has been obtained. The fine material shall then be spread over the layer by hand mechanical means. The application of fine material shall be made gradually in successive layers not exceeding 25mm in thickness and each be worked into the voids in the coarse aggregate before the application of the succeeding layer. The fine material shall be laid as described and brushed into the course aggregate and rolled and consolidated by an approved vibrating roller feed to the bottom of the layer.

Final compaction shall be by an 8-10 tonnes smooth-wheeled roller until there is no visible movement under the action of the roller and until the required tolerances are achieved. Water may be applied during final compaction subject to the Engineer's approval.

Compaction shall in any case achieve 100% maximum dry density in accordance with B.S. 1377.

18.5.7 Quarry waste

Quarry waste shall mean material to the same specification as crusher dust, except as follows:- ii). The material may have up to 35% of stones not larger than 38mm provided that the material passing the 5mm sieve is within the limits specified.

Quarry waste shall be clean and completely free from earth, organic or other foreign matter.

i). The plasticity index taken on material passing the No. 36 sieve shall not exceed 16%

18.5.8 <u>Basecourse finish</u>

The surface of the base course shall be finished to the levels, falls and crossfalls shown on the Drawings subject to the following.

i). The level shall be within + or - 12mm of the levels shown on the Drawings.

ii). The falls shall be within 19% of the falls shown on the Drawings.

iii). The smoothness shall be such that departures from a 3 metre straight edge laid in any direction shall not exceed 12mm..

The surface of the basecourse shall be inspected and approved by the Engineer before bitumen paving is commenced.

Immediately before applying the priming coat, the surface of the basecourse shall be brushed free from dust and loose stones. The material for the priming coat shall be a cutback of M.C.O. grade or other approved.

Approximately 30 minutes before applying the priming coat the surface of the basecourse should be made slightly damp by use of a water spray.

The priming coat shall be applied at a temperature of 100-150 degrees Fahrenheit at a rate of 0.60 litres per square meter.

After application of the primer graded premix of 30mm to 40mm compacted thickness shall be used, with a seal coat.

18.5.9 <u>Bitumen macadam surfacing</u>

A single course open graded premix of 30mm to 40mm compacted thickness shall be used, with a seal coat.

Course aggregate shall be crushed blacktrap with particles having a cubicle shape to the Engineer's approval and shall be washed free from dust.

The Coarse aggregate gradings shall be:-

Sieve Size	Percentage passing
19 mm	100
13 mm	60 - 100
10 mm	45 - 70
6 mm	30 - 50
4 mm	25 - 40
8 mm	15 - 25
200 mm	2 - 5

The binder shall be shellmac MC/RC2 or other approved. The percentage by weight of binder shall be 4.5%. Mixing shall be in an approved mixer and mixing shall proceed until the stone is evenly coated with binder. The temperature (at mixing) shall be within the following range:-

	Aggregate		Binder	
Mixing Temperature	50°	95° F	125°	- 150° F

The laying temperature shall be not less than 20° F below the mixing temperature.

The mix shall be spread evenly over the primed surface and shall be thoroughly compacted by rolling with a minimum of 6 passes. A smooth-wheeled roller of not less than 5 tonnes weight and with rear wheel loading of 0.25 kg per square millimeter width shall be used.

18.5.10 <u>Rolling</u>

Any longitudinal joints shall be rolled first, after which rolling shall start longitudinally at the side and proceed towards the center of the carpet. Each pass of the roller shall overlap the preceding one by at least one half width of the rear wheel. Alternate passes of the roller shall be of varying length. Immediately following initial compaction, the surface shall be checked with a straight edge to ensure that it meets the surface finish requirements.

Minor variations shall be corrected by rolling, but major imperfections shall be compacted by adding or taking away mix while it is still workable.

18.5.11 Surface finish

The surface of the bitumen macadam shall be finished to the levels, contours and slopes shown on the Drawings with the following tolerances:-

i). The level shall be within + or - 6mm. of the level shown on the drawings.

ii). The gradient shall be within 10% of the gradient shown on the drawings.

iii). The smoothness shall be such that departures from a 3 metre straight edge laid in any direction shall not exceed 6mm.

18.5.12 Seal coat

The seal coat shall consist of precoated fines consisting of crushed blackstrap stone graded from 3mm to dust, or coarse sand. The binder shall consist of 4.5% by weight of MC/RC2. The seal coat shall be spread and brushed into the macadam surface at the rate of 180 square metres per tonne and compacted by rolling as for the macadam.

19.0 PLUMBING AND ENGINEERING INSTALLATIONS

19.0 PLUMBING AND ENGINEERING INSTALLATIONS

19.1.0 STANDARDS AND CODES OF PRACTICE

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

19.1.1 British Standards

a)	B.S. 416	Cast Iron spigot and socket soil, waste and ventilating pipes (sand cast and spun) and fittings.
b)	B.S. 2871 part	Copper and Copper Alloy Tubes (for water, gas and sanitation)
c)	B.S. 864 part	Capillary and compression fittings of copper and copper alloy.
d)	B.S. 1184	Copper and Copper Alloy Traps
e)	B.S. 4576	Unplasticised P.V.C. rainwater goods.
f)	B.S. 3974	Pipe supports.
g)	B.S. 1494	Fixing accessories for building purposes (gutter bolts, pipe brackets)
h)	B.S. 1212 part 1+2	Ball valves (excluding floats)
i)	B.S. 2456	Floats for ball valves (plastic) for cold water.
k)	B.S. 1125	W.C. flushing cisterns.
l)	B.S. 417 part 1+2	Galvanised mild steel cisterns, covers, tanks and cylinders.
m)	B.S. 2760	Pitch-impregnated fibre pipes and fittings.
n)	B.S. 1387	Steel cubes and tubulars.
o)	B.S. 4514	Unplasticised P.V.C. solid and ventilating pipe, fittings and accessories.
p)	B.S. 3505	Unplasticised P.V.C. pipes for cold water services
q)	B.S. 143 and 1256	Malleable cast iron and cast copper alloy,screwed pipe fittings.

r) B.S. 78 part 2 and B.S. 1180 Cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings.

s) B.S. 1010 part 1+2 Draw-off taps and stop valves for water services.

Codes of Practice

a) C.P. 304 Sanitary pipework above ground.

b) C.P. 310 Water supply

c) C.P. 305 Sanitary appliances.

d) NOTE: 01. The contractor's attention is drawn to Section"Q" of the Standard Method of Measurements.

02. The whole of the work shall be executed by an approved licensed sub-contractor.

19.2.0 PIPEWORK AND FITTINGS

Black steel and pipework up to 65 mm nominal bore shall be manufactured in accordance with B.S. 21. All fittings shall be of malleable iron and manufactured in accordance with B.S. 143.

Pipe joints shall be screwed and socketed and sufficient coupling and unions shall be allowed so that fittings can be disconnected without cutting the pipe. Running niples and long screws shall not be permitted unless exceptionally approved by the architect.

All black steel pipework - 80 mm nominal bore up to 150 mm nominal bore, shall be manufactured to comply in all respects with the specifications for 65 mm pipe, except that screwed and bolted flanges shall replace union and couplings for the pointing of pipes to valves and other items of plant.

All flanges shall comply with the requirements of B.S. 10, to relevant classifications contained hereinafter.

19.2.1 Galvanised Steel Pipe

Galvanised steel pipe shall be manufactured to comply in all respects with the standards described for black steel pipework above.

Galvanised shall be carried out in accordance with the requirements of B.S. 1387 and 143 respectively.

19.2.2 Copper Tubing

All copper tubing shall be manufactured in accordance with B.S. 659 from C. 106 'Phosphorus
De-oxidised Non-Arsenical Copper' in accordance with B.S. 1172.

Pipe joints shall be made with soldered capillary fittings and connections to equipment shall be with compression fittings manufactured in accordance with B.S. 864.

Short copper connecting tubes between galvanised pipework and sanitary fitments shall not be used because of the risk of galvanic action.

If, as may occur in certain circumstances, it is not possible to make the connections in any other way than by the use of copper tubing, then a brass straight connector shall be positioned between the galvanised pipe and the copper tube in order to prevent direct contact.

19.2.3 Plastic Pipes

P.V.C. pipework and fittings for the use above ground in connection with internal building services shall be in the Terrain soil, waste and ventilation system to B.S. 4514 in modified PVC. The sub-contractor is referred to Product Catalogues in respect of Terrain Plastics Systems for the Building Industry before and after submission of tenders as no claims for want of knowledge will be entertained.

19.2.4 Cast Iron Pipework

Cast iron pipework and fittings for use above ground in connection with internal building services, shall be manufactured with spigot and socket joints of the weight required by the Local Authority and shall comply fully with the requirements of B.S. 416.

All joints on cast iron spigot and socket pipes shall be made with an approved cold caulking compound and so installed as to allow for any expansion or contraction which may take place.

All cast iron pipework, branches, tees, bends and other fittings shall be supplied complete with inspection covers for cleaning purposes. These inspection covers for cleaning purposes shall be included as part of the fittings and shall comply with the requirement of B.S. 416.

19.2.5 Pitch Fibre Pipework

Pitch fibre pipework and fittings for use in connection with external drainage services shall be manufactured in accordance with the requirements of B.S. 2760. Pipes shall be connected by means of purpose made tapered joints manufactured in accordance with B.S. 2760.

Until such time as the use of pitch impregnated fibre pipes is covered by Code of Practice, the jointing, laying and cutting of these pipes shall be carried out in accordance with the requirements of the notes under Appendix C of B.S. 2760.

19.2.6 Asbestos Cement Pressure Pipes

Where asbestos cement pressure pipes and fittings are used in connection with external, above ground or buried water services, they shall be manufactured in accordance with the requirements of B.S. 486.

The classification of these pipes falls into four classes A, B, C, and D respectively, and the class to be used shall depend upon the pressure conditions pertaining at site.

Where cast iron detachable joints are used for connecting pipes, the material shall comply with B.S. 1452 and be suitably protected with a non-toxic compound against corrosion.

When jointing components are made in any other material for which there is no B.S. Specification, then the materials used shall be of a quality not less than required by this standard.

Rubber jointing rings shall be used for sealing purposes and shall comply with the requirements of B.S.2494 except where they are likely to be contaminated by oil products, in which case the gaskets shall be manufactured in accordance with B.S. 3514.

19.3.0 VALVES

14.3.1 Draw-off and Stop Valves (up to 50 mm Nominal Bore)

Draw off taps and stop valves up to 50 mm nominal bore, unless otherwise stated or specified, for attachment or connection to sanitary fitments shall be manufactured in accordance with the requirements of B.S. 1010.

19.3.2 Gate Valves

All gate valves 80 mm nominal bore and above, other than those required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of B.S. 3464.

All gate valves required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of B.S. 1218.

All gate valves up to and including 65 mm nominal bore shall be of bronze construction in accordance with the requirements of B.S. 1952.

The pressure classification of all gate valves shall depend upon the pressure conditions pertaining to the Site of Works.

19.3.3 Globe Valves

All globe valves up to and including 65 mm nominal bore shall be of bronze construction in accordance with B.S. 2060.

All globe valves 80 mm nominal bore and above shall be of cast iron construction in accordance with the requirements of B.S. 3961.

The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the Site of Works.

19.3.4 Check or Non-return Valves

All check or non-return valves up to and including 65 mm nominal bore shall be of the swing check of bronze construction in accordance with B.S. 1953.

All check or non-return valves 80 mm nominal bore and above shall be of the swing check type of cast iron construction in accordance with the requirements of B.S. 4090.

The pressure classification of all check or non-return valves shall depend upon the pressure conditions pertaining to the Site of Works.

19.3.5 Ball Valves

All ball valves for use in connection with hot and cold water services shall be of the Portsmouth type in accordance with the requirements of B.S. 1212, constructed from bronze or other corrosion resistant materials. These valves fall into three pressure classification as follows:-

a)	Low Pressure	3,538 b maximum
b)	Medium Pressure	7,725 b maximum
c)	High pressure	12,620 b maximum

The pressure classification required for each ball valve will be designated in the description of its associated equipment contained in Part C of the Specification.

19.3.6 Manually Operated Mixing Valves

Mixing valves for shower fittings and other appliances being provided under the sub-contract works shall be manufactured in accordance with the requirements of B.S. 1415 from bronze or other corrosion resistant materials.

19.4.0 PIPE SUPPORTS

19.4.1 General

This sub-clause deals with pipe supports securing pipes to the structure of buildings for above ground application.

The variety and type of supports shall be kept to a minimum and their design shall be such as to facilitate quick and secure fixings to metal, concrete, masonry or wood.

Consideration shall be given, when designing supports to the maintenance of desired pipe falls and the restraining of pipe movements to a longitudinal axial direction only.

The sub-contractor shall supply and install all steelwork forking part of the pipe support assemblies and shall be responsible for making good any damage to building work associated with the pipe support installation.

The sub-contractor shall submit all his proposals for pipe supports to the Engineer for approval before any erection work commences.

19.4.2 Steel and Copper Pipes and Tubes

Pipe runs shall be secure by pipe clips connected to pipe hangars, wall brackets, or trapeze type supports. 'U' bolts shall not be used as a substitute for pipe clips without the prior approval of the engineer.

An approximate guide to the maximum permissible support spacings in metres for steel and copper pipes and tubes is given in the following table for horizontal runs:-

Size Nominal Bores	Copper Tube	Steel Tube
15 mm	1.25 m	2.0 m
20 mm	2.0 m	2.5 m
25 mm	2.0 m	2.5 m
32 mm	2.5 m	3.0 m
40 mm	2.5 m	3.0 m
50 mm	2.5 m	3.0 m
65 mm	3.0 m	3.5 m
80 mm	3.0 m	3.5 m
100 mm	3.0 m	4.0 m
125 mm	3.5 m	4.5 m
150 mm	3.5 m	5.5 m

The support spacings for vertical runs shall not exceed one and a half times the distance given for horizontal runs.

19.4.3 Cast Iron and Asbestos Cement Spigot and Socket Jointed Pipes

Cast iron and asbestos cement socketed pipes shall generally be supported at every socket joint by means of either holderbats secured rigidly to the structure or purpose made straps for attachment to rigid steel support brackets.

When holderbats are used, they shall conform to the requirements of B.S. 416.

Suitable anchors shall be provided at all changes of pipes direction junctions and tees, to counteract the effect of end thrust loads.

19.4.4 Asbestos Cement Pressure Pipes

Asbestos cement pressure pipes with either cast iron detachable joints or asbestos cement screw joints shall be supported and anchored on either of the joint. The joint shall remain free.

Pipe hangars and trappers type supporters shall not be suitable for the suspension of asbestos pressure pipes unless they are designed with suitable restrictions to prevent swinging while at the same time providing the necessary support requirements.

Within buildings, asbestos pressure pipes shall be carried out either on concrete supports or on rigidly fixed steel wall brackets.

Suitable anchors shall be provided at all changes of pipe direction, junctions, and tees to counteract the effect of end thrust loads.

19.4.5 Concrete and Pitch Fibre Pipes

These pipes shall NOT be used for above ground application.

19.4.6 Expansion Joints and Anchors

Where practicable, cold pipework systems shall be arranged with sufficient bends and changes for direction to absorb pipe expansion providing that the pipe stresses are contained within the working limits prescribed in the relevant B.S. specifications.

The sub-contractor shall pay particular care when supporting cast iron and asbestos cement pipes in order to ensure that settlement and building movements shall not break the pipe joints.

Where piping anchors are supplies, they shall be fixed to the main structure only. Details of all anchors design proposals shall be submitted to the architect for approval before erection commences. The sub-contractor when arranging his piping shall ensure that no expansion movements are transmitted directly to connections and flanges on pumps or other items of plant. The sub-contractor shall supply flexible joints to prevent vibrations and other movements being transmitted from pumps to the piping systems or vice-versa.

19.5.0 SANITARY APPLIANCES

All sanitary appliances supplied and installed as part of the sub-contract works shall comply with the general requirements of B.S. Code of Practice 305 and the particular requirements of the latest applicable B.S. Specifications.

19.6.0 GENERAL

'Fulbora' rainwater outlets shall be 100 mm and 150 mm diameter as manufactured by Fulbora Limited (UK) or other equal and approved.

The words "pipe" or "tube" shall be synonymous wherever used herein or in any of the contract documents. Pipe sizes stated herein are nominal bore.

Rates shall allow for holderbats at centres not exceeding 1000 mm, cutting and priming to concrete block or in-situ concrete walls and making good.

Rates for all tubing shall include for all joints in the running length.

Rates for galvanised mild steel tubing not exceeding 20 mm diameter shall include for all sockets, connectors, back-nuts, plugs, caps, elbows, bonds and made bends, made springs and made effects.

Rates for fittings on pipes shall include for all cutting and fitting of pipes to same.

The sizes stated of reducing fittings are those of tubes which will be attached to fittings and rates shall include for any additional socket reducers necessary to obtain the stated reduction should it be impossible to accomplish this with only one fitting.

Pipes shall be fixed at least 25 mm clear between socket and wall face. Cast iron holderbats shall be fixed at centres not more than 2 metres. Eared pipes must not be used.

All the plumbing and engineering installation shall be tested as instructed and any work not found satisfactory shall be made good at the contractor's expense.

Where tubing is laid in trenches, care shall be taken to ensure that fittings are not strained.

All tubing described as chased into walls shall have the wall face neatly out and chased, the tubing wedged and fixed and plastered over.

All formed bends shall be made so as to retain the full diameter of the pipe.

Cast iron pipes shall be jointed with asbestos yarn and called with another lead or jointed with special jointing compound all to be approved.

All brasswork and fittings shall conform with the requirements of the standard mentioned above. Such fittings shall be either high or low pressure in accordance with the recommendations of the local authority. At commencement of the contract the contractor shall ask the architect for guidance on this point.

All sanitary fittings shall be properly cleaned, polished and left to the satisfaction of the architect on completion.

19.7.0 TESTING AND INSPECTION

14.7.1 Site Tests - Pipework Systems

After laying, jointing and anchoring the main shall be slowly and carefully charged with water, so that all air is expelled and allowed to stand full for three days before testing under pressure.

The test pressure shall be maintained by the pump for about one hour and if there is any leakage, it shall be measured by the quantity of water pumped into the main in that time. A general leakage of one gallon per 25 mm of diameter per 1.6 kilometer per 24 hours per head may be considered reasonable but any visible individual leak shall be repaired.

All water services pipe systems installed above ground shall be tested hydraulically for a period of one hour to not less than one and a half times the design working pressure.

If preferred, the sub-contractor may test the pipe lines in sections. Any such section found to be satisfactory need not be the subject of a further test when the system has been completed, unless specifically requested by the architect.

During the test, each branch and joint shall be examined carefully for leaks, and any defects revealed shall be made good by the subcontractor and the section re-tested.

The sub-contractor shall take all necessary precautions to prevent damage occurring to special valves and fittings during the tests. Any item damaged shall be repaired or replaced at the sub-contractor's expense.

19.8.0 SITE TEST - PERFORMANCE

Following satisfactory pressure tests on the pipework systems, operational tests shall be carried out in accordance with the relevant B.S. Codes of Practice on the systems as a whole to establish that special valves, gauges, controls, fittings equipment and plant are functioning correctly to the satisfaction of the architect.

19.9.0 STERILIZATION OF WATER SYSTEMS

All underground water mains and above ground water distribution systems, cisterns, tanks, etc. shall be thoroughly sterilized and flushed out after completion of all tests and before being fully commissioned for handover.

The sterilization procedure shall be carried out by the contractor/sub-contractor or specialists employed by the contractor/sub-contractor in accordance with the requirements of B.S. Code of Practice 310, Clause 409, to the approval of the architect .

20.0 ELECTRICAL INSTALLATIONS

20.0 ELECTRICAL INSTALLATIONS

20.1.0 GENERAL

This specification is to be read in conjunction with the drawings which are issued with it. Bills of Quantities shall be the basis of all additions and omissions during the progress of the works.

All electrical work shall be carried out under close supervision of a licensed operative of an approved firm of registered Electrical Contractors.

All electrical work shall be executed in strict accordance with the latest editions of the British Standard and other Government Regulations.

The Main Contractor shall at all times co-ordinate his own work and that of all Sub Contractors with the of the Electrical Sub-Contractor.

Special care shall be executed to ensure that all necessary cable trenches are completed before other subsequent floors, paths etc. including the provision of cable ducts, chase, sinking and the like.

No patching up of floors, pavings, plastework etc will be permitted and where, work has to be rebuilt or re-executed due to lack of planning of Sub-Contractor's work, the Contractor will be held responsible for all costs and expenses arising there from.

NOTE: The Contractor's attention is drawn to section "R" of the Standard Method of Measurement.

20.2.0 STANDARD OF MATERIALS

Where the material and equipment are specifically described and named in the Specification followed by approved equal they are so named or described for the purpose of establishing a standard to which the Sub-Contractor shall adhere.

Should the Sub-Contractor install any material not specified here in before receiving approval from the proper authorities, the Engineer shall direct the Sub-Contractor to remove the material in question immediately. The fact that this material has been installed shall have bearing or influence on the decision by the Engineer.

All materials condemned by the Engineer as not approved for use, are to be removed from the premises and suitable materials delivered and installed in their place at the expense of the Sub-Contractor. All materials required for the works shall be new and the best of the respective kind and shall be of a uniform pattern.

20.3.0 WORKMANSHIP

The workmanship and method of installation shall conform to the best standard practice. All work shall be performed by a skilled tradesman and to the satisfaction of the Engineer. Helpers shall have qualified supervision.

Any work that does not in the opinion of the Engineer conform to the best standard practice will be removed and reinstated at the Sub-Contractor's expense.

Permits, Certificates or Licences must be held by all tradesmen for the type of work, in which they are involved where such permits, certificates or licences exist under Government Legislation.

20.4.0 PROCUREMENT OF MATERIALS

The Sub-Contractor is advised that no assistance can be given in the procurement or allotment of any materials or products to be used in and necessary for the construction and completion of the work. Sub-Contractors are warned that they must make their own arrangements for the supply of materials and /or products specified or required.

The Sub-Contractor may be called upon to show evidence that satisfactory arrangements have been made for the procurement of any or all materials and products required to complete the works. Copies of purchase order to suppliers may be requested.

The Sub-Contractor shall be responsible for all site and/or drawing measurements required for completion of quantities or materials required for the proper execution of the works.

No claim for extra payment will be considered on the ground of insufficient knowledge, inaccurate measurements or other errors on the part of the Sub-Contractor.

20.5.0 WORKING DRAWINGS

Before manufacture is begun the Sub-Contractor shall submit six copies of detailed drawings of all pieces of equipment including their components showing all pertinent information including sizes, capacities, construction details, etc., and as may be required to determine the suitability of the equipment for the approval of the Engineer. Approval of the detail drawings shall not relieve the Sub-Contractor of the full responsibility of errors or the necessity of checking the drawings himself or of furnishing the materials and equipment and performing the work required by the plans and specifications.

20.6.0 RECORD DRAWINGS

The Engineer will supply the Sub-Contractor with an extra set of white prints on which he shall clearly mark as the job progresses, all changes and deviations from the proposed installation so that the Architect at the completion the job, will have a record of the exact location of all piping and equipment.

The Sub-Contractor shall also furnish, within a reasonable time after the completion of the works and prior to the final payment being sanctioned, drawings and diagrams of the works completed and relating to the whole installation and plant.

These diagrams and drawings shall show the complete installation including sizes, runs and arrangements of the installation. The drawings shall be to a scale not less than 1.50 and shall include plan views and sections.

The drawings shall all details which may be useful in the operation, maintenance or subsequent modifications or extensions to the installation.

Three sets of diagrams and drawings shall be provided, all to the approval of the Engineer.

One coloured set of line diagrams relating to operating and maintenance instructions shall be framed and mounted in a suitable location.

20.7.0 REGULATIONS AND STANDARDS

All work executed by the Sub-Contractor shall comply with the current edition of the "Regulations" for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers and with the Regulations of the Local Electricity Authority.

Where the two sets of regulations appear to conflict, they shall be clarified with the Engineer. All materials used shall comply with relevant British Standard Specification.

20.8.0 SETTING OUT WORK

The Sub-Contractor at his own expenses, is to set out works and take all measurements and dimensions required for the erection of his materials on site, making any modifications or alterations in detail to the Engineer before proceeding and must allow in his Tender for all such modifications and for the provision of any sketches or drawings related thereto.

20.9.0 POSITIONS OF ELECTRICAL PLANT AND APPARATUS

The routes of cables and approximate positions of switchboards, etc., as shown on the drawings shall be assumed to be correct for purposes of Tendering, but the exact positions of all electrical Equipment and routes

of cables must be agreed on site with the Engineer before any work is carried out.

20.10.0 M.C.B. DISTRIBUTION PANELS AND CONSUMER UNITS

All cases of M.C.B. panels and consumer units shall be constructed in heavy gauge sheet with hinged covers.

Removable undrilled gland plants shall be provided on the top and bottom of the cases. Miniature circuit breakers shall be enclosed in moulded plastic with tripping mechanism and chambers separated and sealed from the cable terminals.

The operating dolly shall be tripfree with a positive movement in both make and break position. Clear indication of the position of the handle shall be incorporated.

Removable undrilled gland plates shall be provided on the top and bottom of the cases. Miniature circuit breakers shall be enclosed in moulded plastic with the tripping mechanism and arc chambers separated and sealed from the cable terminals.

The tripping mechanism shall be on inverse characteristic to prevent in temporary overloads and shall not be affected by normal variation in ambient temperature

The breakers shall be ground in distribution panels as specified in part 111 of this specification, all live metal being shrouded or concealed during normal used.

A locking plate shall be provided for each size of breaker. A complete list of circuit details on typed cartridge paper glued to stiff cardboards and covered with sheet of perpex, and held in position with four suitable fixings, shall be fitted to the inner face of the lids of each distribution panel. The appropriate M.C.B. ratings be state on the circuit chart against each circuit in use. Ivorine labels shall be secured to the insulation barriers in such a manner as to indicate the number of the circuit shown on the circuit chart.

Insulated barriers shall be fitted between phases, and neutrals in all boards, and shroud live parts.

Neutral cables shall be connected to the neutral bar in the same sequence as the phase cables are connected to the M.C.B's. This shall also apply to earth bars when installed.

20.11.0 FUSED SWITCHGEAR AND ISOLATTORS

All fused switchgear and isolators whether mounted on machinery, walls or industrials panels shall conform to the requirement of B.S 861.1955 and where applicable to B.S 2510.

All contacts are to be fully shrouded and are to have a breaking capacity on manual operations as required by B.S 861, 1955.

Fuse links for fused switches are to be of high rupturing capacity cartridge type, conforming to B.S. 88.1952 category of duty 44ov A.C.

Isolators shall be load braking/fault making isolators.

Fused switches and Isolators are to have separate metal enclosures. Mechanical interlocks are to be provided between the door and main switch operating mechanism so arranged that the door may not be opened with the switch in the "ON" position.

Similarly it shall not be possible to close the switch with the door open except that provision shall be made within the switch for authorized persons to defeat the mechanical interlock and close the switch with the door in the open position for test purposes. The "ON" and "OFF" positions of all switches and isolators shall be clearly indicated by a mechanical lag indicator or similar device. In T.P. & N. fused switch units, bolted neutral links are to be fitted.

20.12.0 <u>CONDUITS AND CONDUIT RUNS</u>

Conduit systems are to be installed so as to allow the loop in system of wiring.

All conduit shall be blak rigid super high impact heavy gauged class "A" PVC in accordance with B.S. 2782 and I.E.E. Regulations B101 - 105 tests and as manufactured by Egatube Re: HIP or other approved equal to B.S. 4607; part 1970. No conduit less than 20mm. in diameter shall be used anywhere in this installation.

Conduit shall be installed in plaster work and floor screed.

except when run on wooden or metal surface when they will be installed surface supported with saddles every 600mm. Conduit run in chases shall be firmly held in position by means of substantial pipe hooks driven into wooden plugs.

The Sub-Contractor's attention is drawn to the necessity of keeping all conduits entirely separate from other piping services such as water and no circuit connections will be permitted between conduits and such pipes.

All conduits systems shall be arranged possible to be self-draining to switch boxes and conduit outlet points for fittings. The systems, when installed and before wiring shall be kept plugged with well fitting plugs and when short conduit pieces are used as plugs, they shall be doubled over and tied firmly together with steel wire. Before wiring all conduit systems shall be carried out until the particular section of the conduit installation is complete in every respect.

The sets and beds in conduits runs are to be formed on site using appropriate size bending springs and all radii of bends must not be less than 2.5 times the outside diameter of the conduit. No solid or inspection bends, tees or elbows will be used.

Conduit connections shall either be by a demountable (screwed up) assembly or adhesive fixed and watertight by solution as Egaweld. The tube and fittings must be clean and free of all grease before applying the adhesive. When connections are made between conduit and switch boxes, circular or non-screwed boxes, care shall be taken that no rough edges of conduit stick out into the boxes.

Runs between drawn-in boxes are not to have more than two right angle bends or their equivalent. The Sub-Contractor may be required to demonstrate to the Engineers that wiring in any particular run is easily with drawable and the Sub-Contractor may, at no extra cost to the contract, be required to install additional draw-in boxes required. If conduit is installed in straight runs in excess of 6000mm, expansion couplings as manufactured by Egatube Ref: EEC shall be used at intervals of 6000mm.

Where conduit runs are to be concealed in pillars and beams, the approval of the Structural Engineer shall be, obtained. The Sub-Contractor shall be responsible for marking the accurate position of all holes, chases etc., on site, or if the Engineer so direct, shall provide the main Contractor with dimensional drawings to enable him to mark out and form all holes and chases. Should the Sub-Contractor fail to inform the main Contractor of any inaccuracies in this respect they shall be rectified at the Sub-Contractor's expense.

Site, details of reinforced concrete or structural steel work and check from the builder's drawings the positions of walls, structural concrete and finishes. No reinforced concrete or steelwork may be drilled without first obtaining the written permission of the structural Engineer.

The drawings provided with these specifications indicate the appropriate positions only of points and switches, and it shall be the Sub-Contractor's responsibility to mark out and centre on the site the accurate positions where necessary in consultation with the Architect and the Engineer. The Sub-Contractor alone shall be responsible for the accuracy of the final positions.

20.13.0 CONDUIT BOXES AND ACCESSORIES

All conduit outlets and junction boxes are to be either malleable iron and of standard circular pattern to B.S. 31 of the appropriate type of suit saddles being used or super high impact PVC manufactured to B.S. 4607: 1, 1970.

Small circular pattern boxes are to be used with conduits up to and including 25mm. outside diameter. Rectangular pattern adaptable boxes are to be used for conduits of 32mm outside diameter and larger. For drawing in of cables in exposed runs of conduit, standard pattern through boxes are to be used.

Boxes are to be not less than 50mm. deep and of such dimensions a will enable the largest appropriate number of cables for the conduit sizes to be drawn in without excessive bending.

Outlet boxes for lighting fittings are to be of the loop-in type where conduit installation is concealed and the Sub-Contractor shall allow one such box per fitting, except where fluorescent fittings are specified when two such boxes per fitting shall be fitted flush with the ceiling and if necessary fitted with break joint rings. Pattresses shall be fitted where required to outlets on surface conduit runs.

Adaptable boxes are to be of P.V.C. or mild steel (of not less than 12 s.w.g.) and black enamelled or galvanised finish according to location. They shall be of square or oblong shape complete with lids secured by four 2 BA brass roundhead screws. No adaptable box shall be less than 75mm x 75mm x 50mm or larger than 300mm x 300mm x 75mm and shall be adequate in depth in relation to the size of conduit bushes.

20.14.0 LABELS

Labels fitted to switches and fuseboards:-

i). Shall be Ivorine engraved black on white

ii). Shall be secured by R.H. brass screws of same manufacture throughout.

iii). Shall indicate on switches:-

a). Reference number of switch

b). Specified current rating

c). item of equipment controlled

iv). Shall indicate on M.C.B. panels

a). Reference number

b). Type of board, i.e. lighting, sockets, etc.

c). Size of cable supplying panel

d). Where to isolate feeder cable

v). Shall be generally not less than 75mm x 50mm.

20.5.0 <u>EARTHING</u>

The earthing of the installation shall comply with the following requirements:-

It shall be carried out in accordance with the appropriate sections of the current edition of the Regulations, for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers.

At all main distribution panels and main service positions a 25mm x 3mm minimum cross sectional area Copper tape shall be provided and all equipment including the lead sheath and armouring of cables, distribution boards and metal frames shall be bonded thereto.

The earth tape in Sub-Clause (ii) shall be connected by means of a copper tape or cable of suitable cross sectional area to an earth electrode which shall be a earth (see later sub-clause).

All taoes to be sort high conductivity copper, intinned except where otherwise specified and where run underground on or through walls, floors, etc., it shall be served with corrosion resisting tape or coated with corrosion compound and braided.

Where the earth electrode is located outside the building a removable test link shall be provided inside the building as near as possible to the point of entry to the tape, for isolating the earth electrode for testing purpose.

Earthing of sub-main equipment shall be deemed to be satisfactory where the sub-main cables are M.I.C.S. or conduit with separate earth wire, and the installation is carried out in accordance with the figure stated in the current edition of the I.E.E. Regulations.

Where an earth rod is specified (see Sub-Clause (iii) it shall be proprietary manufacture, solid hand drawn copper of 15mm diameter driven into the ground to a minimum depth of 3.6m. It shall

be made up to 1.2m sections with internal screw and socket joints and fitted with hardened steel tip and driving cap.

Earth plates will not be permitted

Where an earth rod is used the earth resistance shall be tested in the manner described in the current edition of the I.E.E. Regulations, by the Sub-Contractor in the presence of the Engineer and the Sub-Contractor shall be responsible for the supply of all test equipment.

Where copper tape is fixed to the building structure it shall be by means of purpose made non-ferrous saddles which space the conductor away from the structure a minimum distance of 20mm. Fixings, shall be made using purpose made plugs. No fixings requiring holes to be drilled through the tape will be accepted.

Joints in copper tape shall be tinned before assembly rivetted with a minimum of two copper rivets and sweated solid.

Where holes are drilled in the earth tape for connection to items of equipment the effective cross sectional area regulations.

Bolts, nuts, and washers for any fixing to the earth tape must be non-ferrous material.

Attention is drawn to the need for the earthing metal parts of lighting fittings and for bonding ball joint suspension in lighting fittings.

20.16.0 CABLES AND FLEXIBLE CORDS

All cables used in this Sub-Contact shall be manufactured in accordance with the current appropriate British Standard Specification which are as follows:-

a). Rubber Insulated Cables and Flexible Cords - B.S.S. 6500

b). P.V.C. Insulated Cables and Flexible Cords - B.S.S. 6004

c). P.V.C. Insulated Armoured Cables - B.S.S. 6346

d). Butyl Rubber Insulated Cables - B.S.S. 610V

The successful Sub-Contractor will, at the Engineer discretion be required to submit samples of cables for the Engineer's approval; the Engineer reserves the right to call for the cables of an alternative manufacture without any extra cost being incurred.

Insulated cables shall be 500/100 Volt grade. No cables smaller than 1.5mm sq. shall be used unless shall be as detailed in later clauses.

The colour of cables shall conform with the details stated in the "Cable Braid and insulation Colours" Clause.

20.7.0 ARMOURED P.V.C INSULATED AND SHEATHED CABLES

Shall be 600/1000 volt grade manufactured to B.S. 6346:1969 with copper stranded conductors.

The wire armour of the cables shall be used wholly as an earth continuity conductor and the resistance not more than twice of the largest current carrying conductor of the cable.

P.V.C./S.W.A./P.V.C. cables shall be terminated using "Telecom" "B" type or approved equal glands and P.V.C. tapered sleeve shall be provided to shroud each glad.

Where cables rise from floor level to switchgear etc., they shall be protected by P.V.C. conduit, to a height of 600mm from finished floor level, whether the cable is run on the surface or recessed into the wall.

20.18.0 ROAD CROSSING DUCTS

Underground P.V.C. or pitch fibre ducts crossing the roads, shall be buried 500mm below ground level, and surrounded with 150mm layer of 1:3:6 concrete mix.

20.19.0 CABLES SUPPORTS, MARKERS AND TILES

All P.V.C./S.W.A./P.V.C. cables run inside the building shall be fixed in rising ducts or on ceilings by means of die cast cables hooks or clamps, of appropriate size to suit cables, fixed by studs and back nuts their channel sections.

Alternatively, fixing shall be by B.I.C.C. claw type cleating system with die-cast cleats and galvanized mild steel back straps or similar approved equal method. For one or two cables run together the cleats shall be fixed a special channel section supports or backstraps described above which shall in turn be secured to walls or ceilings of ducts by rawbolts.

In excessively damp or corrosive atmospheric conditions special finishes may be required and the Sub-Contractor shall apply to the Engineer for further instructions before ordering cleats and channels for such areas.

The above type of hooks and clamps and channels of cleats and backstraps shall also be used for securing cables in vertical ducts.

Cables supports shall be fixed at 600mm maximum intervals, the supports being supplied and erected under this Sub-Contract. Saddles shall not be used for supporting cables nor any other type of fixing other than one of the two methods described above or other system which has been received prior to approval of the Engineer.

Cables are to be kept clear of all pipe work and the Sub-Contractors shall work in close liaison with other services Sub-Contractors.

The Sub-Contractor shall include for the provision of fixing of approved type coloured slip on cables end makers to indicate permanently the correct phase and neutral colours on all cable ends.

Provision shall be made for supplying and fixing approved non-corrosive metal cable makers to be attached to the outside of all P.V.C. / S.W.A. /P.V.C. cables at 15 intervals indicating cable side and distinction.

Where P.V.C. / S.W.A. / P.V.C. cables are run outside the building they shall be laid underground 750mm. deep with protecting concrete interlocking cover tiles laid over which shall be provided and laid under this Sub-Contractor. All necessary excavations and reinstatement of ground including sanding or trenches will be carried out by the Sub-Contractor, unless otherwise stated.

20.20.0 P.V.C. INSULATED CABLES

Shall be of non-braided type as C.M.A. reference 6491 x 600/1000/1000 volt grade cables, or equal approved.

P.V.C. cables shall conform to the details of the "Cables and Flexible Cords" and "Cables Braid and Insulation Colours" clauses.

20.21.0 HEAT RESISTING CABLES

Final connections to cookers, water heaters, etc., shall be made using butyl rubber insulated cable as C.M.A. reference 610V buty1 (single core 600/1000 volt).

This type of cable shall be used in all instances where a temperature exceeding100^{o} F, but not exceeding 150^{o}F is likely to be experienced be made using silicone rubber insulated cable or equal approved.

20.21.0 FLEXIBLE CORDS

Shall be in accordance with the "cable and flexible Cords" clause. No Cord shall be less than 24/0.2mm in size unless otherwise specified.

Circular white twin T.R.S. flex shall be used for plain pendant fittings up to 100 watts. For all types of lighting fittings the flexible cable shall be silicone rubber insulated.

No polythene insulated flexible cable shall be used in any lighting fitting or other appliance (see "Heat Resisting Cables" Clause 30).

20.23.0 CABLES ENDS AND PHASE COLOURS

All cable ends connected up in switchgear, M.C.B. panels etc., shall have the insulation carefully cut back and the ends sealed with Hellerman rubber slip on cable end makers.

The makers shall be of appropriate phase colorful switch and all other live feeds to the details of the "Cable Insulation Colours" clause. Bank cable with black end makers shall only be used for neutral cables.

15.24.0 CABLE INSULATION COLOURS

Unless otherwise stated in later clauses the insulation colours shall be in accordance with the following table.

Where other systems are installed the cable colours shall be in accordance with details stated in the appropriate clause.

20.25.0 ELECTRICAL INSTALLATIONS

SYSTEM	INSULATION	CABLE END MAKER
LIGHTING AND POWER		
1). Main and Sub-Main		
a). Phase	Red	Red
b). Neutral	Black	Black
2). Sub-Circuit Single phase		
a). Phase	Red	Red

b). Neutral Black Black

20.26.0 SUB-CIRCUIT WIRING

For all lighting and sockets wiring shall be carried out in the "looping in" system and there shall be no joints whatsoever. No lighting circuits shall comprise more than 20 points when protected by 100A MCB. Cables with different cross-section area of copper shall not be used in combination.

Lighting circuits P.V.C. cable

a). 1.5mm sq. for all lighting circuits indicated on the drawing. Power circuits P.V.C. Cable

b). 2.5mm^2 for one, two or three 5 Amp sockets wired in parallel.

c). 2.5.mm^2 for one 15 Amp socket.

d). 2.5mm^2 for a maximum of ten switched 13 Amp sockets wired from a 30 Amp fuseway.

The wiring sizes for lighting circuits and sockets are shown on the drawings. In such cases, the sizes shown on the drawings shall prevail over the sizes specified.

Wiring sizes for other appliances shall be as shown on the drawing or specified in later clauses of this specification.

20.27.0 SPACE FACTOR

The maximum number of cables that may be accommodated in a given size of conduit or trunking or duct is not to exceed the number in Tables B.5 and B.6 or

as stated in Regulation B91, B.117 and 118 of the I.E.E Regulations whichever is appropriate.

20.28.0 INSULATION

The insulation resistance to earth and between poles of the whole wiring system, fittings and lumps, shall not be less than the requirements of the latest edition of the I.E.E. Regulations. Complex tests shall be made on all circuits by the Sub-Contractor before the installations are handed over.

A report of all tests shall be furnished by the Sub-Contractor to the Engineer. The Engineer will then check test with his own instruments if necessary.

20.29.0 LIGHTING SWITCHES

These shall be mounted flush with the walls, shall be contained in steel or alloy boxes and shall be of the gangs, ratings and type shown in the drawings. They shall be as manufactured by M.K. Electrical Ltd., other equal and approved to B.S. 3676.1963.

20.30.0 SOCKETS AND SWITCHED SOCKETS

These shall be flush pattern in steel box and shall be of the gangs and type specified in the drawings.

They shall be 13 - amp., 3-pin, shuttered, switched and as manufactured by "M.K. Electrical Co. Ltd. or other approved equal to B.S. 1363.1947.

20.31.0 FUSED SPUR BOXES

These shall be flush, D.P. switched as in steel box of type and make specified in the drawings complete with pilot light and as manufactured by "M.K.Electrical Company Ltd." or other approved equal to B.S. 1953.

20.32.0 COOKER OUTLETS

These shall be flush mounted with 13-A switched socket outlet and the other for the cooker.

The cooker control units shall be as manufactured by "M.K. Electric Company Ltd.," other approved equal to B.S. 4177: 1967.

20.33.0 CONNECTORS

Shall be as specified in the drawings and of appropriate rating. These shall be fitted at all conduit box lighting point outlets for jointing of looped P.V.C. cables of specified quality.

20.34.0 LAMPHOLDERS

Shall be of the extra H.O. skirted pattern and shall be provided for every specified lighting fitting and shall be B.C., E.S. or G.E.S. as required. All E.S. and G.E.S. holders shall be heavy brass type (except for plain pendants where reinforced bakelite type shall be used). The

screwed cap of the E.S. and G.E.S. holders shall be connected to the neutral.

Where lamp holders are supported by flexible cable, the holders shall have "cord grip" arrangements and in the case of metal shades earthing screws shall be provided on each of the folders.

The Sub-Contractor must order the appropriate type of holder when ordering lighting fittings, to ensure that the correct types of holders are provided irrespective of the type normally supplied by the manufacturers.

20.35.0 LAMPS

All lamps shall be suitable for normal stated supply voltage and the number and sizes of lamps detailed on the drawings shall be supplied and fixed. The Sub-Contractor must verify the actual supply voltage with the supply authority before ordering the lamps.

Tungsten filament lamps shall be manufactured in accordance with B.S.S. 161 for general service lamps and B.S.S. 565 for lamps other than general services. Tubular fluorescent lamps shall comply with B.S.S. 1853.

Pearl lamps shall be used in all fittings unless otherwise specified.

20.36.0 TELEPHONE CONNECTION FACILITIES

The Sub-Contractor shall supply and install flush telephone outlets as manufactured by M.K. Electric Co. Ltd. or approved equal and flush galvanised steel telephone entry boxes (T.E.B.) for UTL cables.

The Sub-Contractor shall run 25mm. gauge PVC conduits to link every telephone outlet to its nearest T.E.B. The conduits shall link it from the top to avoid rain water. Sufficient draw wires shall be left in all conduits, accessible at both the outlet and the T.E.B.

20.37.0 AERIAL CONNECTION FACILITIES

The Sub-Contractor shall supply and install flush T.V. coaxial outlet boxes (ACB) by 25mm heavy gauge conduit. A.C.B. 's shall be mounted 300mm from the highest ceiling level of the unit, and the conduit shall link it from the top to avoid rain water.

Sufficient draw wires shall be left, accessible at both ends of the conduit.

20.38.0 LIGHTNING PROTECTION SYSTEM

The Sub-Contractor shall supply and install roof air termination of (20 x 3)mm copper tape fixed on the roof ridge tiles or wall top ends, with purpose made clamps of the right size spaced with a distance of not

more than 1.2m run of the tape. This distance shall be decreased where necessary to obtain the approved rigidity.

The lighting arresters shall be bonded to the copper tape and firmly fixed on the roof to approval.

The down conductors above test clamps shall be 70mm^2 copper conductors in 25mm super high impact heavy gauge column concealed conduits. The shall be bonded to the air termination tapes at approved positions. They shall drop along the vertical lines through approved positions and be connected to earth test clamps mounted 2500mm above ground level.

Apart from down conductors and conduits, all the above installation material and fittings shall be purpose made as manufactured by Furse or approved equal.

The down conductors between the earth test camps and earth electrode shall be two number 35mm^2 copper conductors in parallel. Each shall run in an approved 10mm minimum internal diameter

supper high impact conduit of 26mm minimum wall thickness by IEC ltd. or any recognized manufacturer. These shall be concealed in builder's column, but between the comn and manhole, the sub-contractor shall surround the same by 50mm layer of 1:2:4 cement, sand and 12mm aggregate mixture.

The two down conductors shall be bonded to earth electrode, and connected to test clamp.

20.39.0 <u>LIGHTING FITTINGS</u>

This Sub-Contract shall include for the provision, handling charges, taking the delivery, safe storage, wiring (including internal wiring) assembling and erecting of all lighting fittings shown on the drawings.

All fittings and pendants shall be fixed to conduit boxes with brass R/H screws. These to be in line with metal finish of fittings. The lighting fittings are detailed for the purpose of establishing a high standard of finish and under no circumstances will substitute fittings be permitted.

Incase of rectangular shaped ceiling fittings, the extreme ends of the fittings shall be secured to suitable support n addition to the central conduit box fittings. Supports shall be provided and fixed by the Sub-Contractor.

The whole of the work of each lighting fittings shall be effectively bonded to earth. In the case of ball and/or knuckle joints short lengths of flexible cable shall be provided, bonded to the metal work on either side of the joints. If the above provisions are not made by the manufacturers, the Sub-Contractor shall include cost of

additional work necessary in his tender. See "Flexible Cords for details of internal wiring of lighting fittings. Minimum size of internal wiring shall be 20/0.20mm (23/0067). Each lighting fitting shall be provided with number, type and size of lamps as detailed on the drawings. It is to be noted that some fittings are suspended as shown on the drawings.

20.40.0 POSITIONS OF POINTS AND SWITCHES

Although the appropriate positions of all points are shown on the drawings enquiry shall be made as to the exact positions of all M.C.B. panels, lighting points, socket outlets etc., before work is actually commenced. The Sub-Contractor must approach the Architect with regard to the final layout of all lights on the ceiling and walls.

Where two or more points are shown adjacent to each other on the drawings, e.g. socket and telephone outlet, they shall be lined up vertically or horizontally on the center lines of the units.

Normally the units shall be lined up on vertical centre lines, but where it is necessary to mount units at low level they shall be line up horizontally.

The Sub-Contractor must consult with the Engineer in liaison with the clerk of works, or the General Foreman on site regarding the positions of all points before fixing any conduits etc. the Sub-Contractor shall be responsible for all alterations made necessary by the non-compliance with the clause.

20.41.0 STREET/SECURITY LIGHTING COLUMNS

These shall be mild steel conforming to BS. 1840:1952 and fabricated to Ministry of works design and specification.

The column shall be at a minimum of 225mm in the ground on 75mm thick concrete foundations and the pole up to 6" shall be surrounded with concrete. The top bracket and plain section of the columns shall be common to and interchangeable with all brackets with maximum mismatching tolerance of 3mm between any pole and brackets. After manufacture and before erection the columns shall be treated with an approved mordant solution which shall be washed off and the whole allowed to dry. Thereafter, the columns shall be painted with one undercoat and two coats of gloss paint to an approved colour. All columns shall be complete with fused cut-outs type MC 040 SL. Manufactured by Lucy Oxford or equivalent.

20.42.0 TIMING CONTROL SWITCH

These shall be installed where shown on the drawings. Photocell timing control circuits which will operate 'on' with a specified level

of darkness and 'off' with a given level of light. The initial adjustment will be done with approval of the Electrical Engineer.

20.43.0 WIRING SYSTEM FOR STREETLIGHTING

Cables shall be 4mm^2 PVC/SWA/PVC., 2-core, 3-core and 4-core as indicated on the drawings, and shall be laid in a cable trench 450mm deep along the road sides and 600mm deep across the roads and 900mm away from the road kerb or 1500mm away from the edges of

the road. 'Loop-in' and 'loop-out' arrangements shall be used at every pole. Wiring to the lanterns on each pole shall be with 1.5mm^2 PVC protected by 5A cartridge fuse. Cables across the roads and at the entrance of the plots shall be laid in ducts. No underground joints shall be permitted.

20.44.0 DUCTS

Ducts for the road crossing and the entrance of the plots shall be of concrete pipe jointed in a approved manner, with an internal diameter of not less than 100mm. The ducts shall be laid at least 600mm below the finished road level on a compact bed of murram at least 50mm thick.

20.45.0 METAL CONTROL PILLAR

These shall be metal clad and fabricated to M.O.W. design and specification. The Sub-Contractor shall supply, install, test and commission all control pillars including supplying, fixing connecting switchgears as detailed on the appropriate drawings.

20.46.0 CURRENT OPERATED EARTH LEAKAGE CIRCUIT BREAKER

Current operated earth leakage circuit breaker shall conform to B.S. 4293:63 rated at 240 volts D.P. 50 cycles A.C. Mains.

The breaker shall be provided with test switch and fitted in weather proof enclosure for surface mounting. The rated load current and earth fault operating current shall be as specified in the drawings. These shall be as manufactured by Crabtree, Siemens or other equal and approved.

20.47.0 M.V. SWITCHBOARD AND SWICHGEAR

The switchboards shall be manufactured in accordance with B.S. 162 which co-ordinates the requirements for electrical power switchgear and associated apparatus. It is not intended that this B.S. should cover the requirements for specific apparatus for which separate British Standard exist. All equipment and material used in

the switchboard shall be in accordance with the appropriate British Standard.

The switchboard shall comprise the equipment shown on the drawings together with all current transformers, auxiliary fuses,

labels small wiring and interconnections necessary for the satisfactory operation of the switchboard.

Switchboard shall be of the flush fronted, enclosed, metal clad type with full front or rear access as called for in the particular specification, suitable for indoor use, sectionalized as necessary to facilitate is to be approximate 2.0. metres.

A suitable connection chamber containing all field terminals shall be provided at the top or button of the switchboard as appropriate.

Before manufacture, the sub-contractor shall submit to the consulting engineer for approval of detailed drawings showing the layout construction and connection of the switchboard.

All bus-bars and bus-bar connections shall consist of high conductivity copper and be provided in accordance with B.S. 158 and B.S. 159. The bus-bars shall be clearly marked with the appropriate phase and neutral colours which should be red, yellow, blue for the phases and black for the neutral. The bus-bars shall be so arranged in the switchboard that extensions to the left and right may be made in the future should the need arise.

Small wiring, which be neatly arranged and cleated, shall be executed in accordance with B.S. 158 and the insulation of the wiring shall be coloured according to the phase or neutral connection.

Switches and fuse switches, shall be in strict accordance with B.S. 861 Class 2 Switches. Means of locking the switch in the "OFF" position shall provided.

All fuseswitches shall comply with B.S. 3185 and shall have a fault rating at least equal to the fault rating of switchboard in which they are installed. Cartridge fuse links to B.S. 88 category A.C. 46 Class Q1 and fusing factor not exceeding 1.5 shall be supplied with each fused switch.

Mounting arrangements shall be such that individual complete fuse switches may be disconnected and withdrawn when necessary without extensive dismantling work. When switches are arranged in their formation all necessary horizontal and vertical barriers shall be provided to ensure segregation from adjacent units. Means of locking the switch in the "OFF" position shall e provided.

20.48.0 STEEL CONDUITS AND STEEL TRUNKING

Conduits shall be of heavy gauge class Welded to British Standard specification B.S. 31. In no case will conduit smaller than 20mm diameter be used on the works. Conduits installed within buildings shall be black enameled finish except where specified otherwise where installed externally or in damp conditions they shall be galvanized. Conduit fittings, accessories or equipment used in conjunction with galvanized conduits shall also be in galvanized or otherwise as approved by the service engineer.

Metal trunking shall be fabricated from mild steel of not less than 18 swg. All sections of trunking shall be rigidly fixed together and attached to the framework or fabric or the building at intervals of not less than 1.2m. Joint in trunking shall not overhang points by more than 0.5m.

All trunking shall be made electrically continuous by means of 25 x 3mm copper links across joint and where the trunking is galvanised, the links shall be made by galvanized flat iron strips.

All trunking fittings (i.e. bends, tee, etc) shall leave the main trough completely clear of obstructions and continuously open except through walls and floors at which points suitable fire resisting barriers shall be provided as may be necessary. The inner edge of bends and tees shall be chamfered cables larger than $35mm^2$ are employed.

Where trunking passes through ceilings and walls the cover shall be solidly fixed to 150mm either side of ceilings and floors and 50mm either side of walls.

Screws and bolts securing covers to trunking or section of covers together shall be arranged so that damage to cables cannot occur either when fixing covers or when installing cables in the trough.

Where trunking is used to connect switchgear or fuseboards, such connections shall be made by trunking fittings manufactured for this purpose and not multiple conduit couplings.

Where vertical sections of trunking are used which exceed 4.5m in length, staggered tie off points shall be provided at 4.5m intervals to support the weight of cables.

Unless otherwise stated, all trunking system shall be painted as for conduit.

Where a wiring system incorporates galvanized conduit and trunking, the trunking shall be deemed to be galvanized unless specified otherwise.

The number of cables to be installed in trunking shall be such as to permit easy drawing in without damage to the cables, and shall in no circumstances be such space factor of 45% is exceeded.

Conduit and trunking shall be mechanically and electrically conditinous. Conduit shall be tightly screwed between the various Lengths so that they butt at the socketed joints. The internal edges conduit and all fittings shall be smooth, free from burrs and other defects. Oil and any other insulating substance shall be removed from the screw threads. Where conduits terminate in fusegear, distribution boards, adaptable boxes, non-spouted switchboxes, etc., they shall, unless otherwise stated, be connected thereto by means of smooth bore male

brass bushes, compression washers and sockets. All exposed threads and abrasions shall be painted using an oil paint for black enamelled tubing and galvanised paint for galvanised tubing immediately after the conduits are erected. All bends and sets shall be made cold without altering the section of the conduit. The inner radius of the bed shall not be less than four (4) times the outside diameter of the conduit. Not more than two right angle bends will be permitted without the inner-position of a draw-in-box. Where straight runs of conduit are installed, daw-in- boxes shall be provided at distances not exceeding 15m. No tees, elbows, sleeves, either of inspection or soil type, will be permitted.

Conduit shall be swabbed out prior to drawing in cables, and they shall be laid so as to drain off all condensed moisture without injury to end connections.

Conduits and trunking shall be run at least 150mm clear of hot water steam pipes, and at least 75mm clear of cold water and other services unless otherwise approved by the services Engineer.

All boxes shall conform to B.S. 31, to be of malleable iron, and black enamelled or galvanised accordingly to the type of conduit specified. All accessory boxes shall have threaded brass inserts.

Box lids where required shall be heavy gauge metal, secured by means of zinc plant or cadmium planted steel screw.

All adaptable boxes and lids of the same size shall be interchangeable.

Boxes used on surface work are to be taped or drilled to line up with the conduit fixed in distance type saddles allowing clearance between the conduit and wall without the need for setting the conduit.

Where used in conjunction with mineral insulated copper sheathed cable, galvanized boxes shall be and painted after erection.

Draw-in boxes in the floors are generally to be avoided but where they are essential they must be grouped in positions approved by the services engineer and covered and by suitable floor traps, with non-ferrous trays and covers.

The floor trap covers are to be recessed and filled in with a material to match the surface.

The Sub-Contractor must take full responsibility for the filling in of all covers, but the filling in materials will be supplied and the filling carried out by the Main Building Contractor.

Where buried in the ground outside the building the whole of the buried conduit is to be painted with two coats of approved bitumastic composition before covering up.

Where run on the surface, unpainted fittings and joints shall be painted with two coats of oil bound enamel applied to rust and grease free metal work.

20.49.0 APPLYING FOR AND FOLLOWING UP UEDCL POWER SUPPLY

The Sub-Contractor shall supply for and follow up UEDCL's power supply. He shall make sure there is power up to every meter box on every site before the completion date.

The Electrical Engineer may help in applying only.

20.50.0 TESTING ON SITE

The sub-contractor shall conduit during and at the completion of the installation and, if required, again at the expiration of the maintenance period, tests in accordance with the relevant section of the current edition of the Regulations for the electrical equipment of buildings issued by the I.E.E of Great Britain, the Government Electrical Specification and the Electric supply Company's By-Laws.

Tests shall be carried out to prove that all single pole switches are installed in the 'live' conductor.

Tests shall be carried out to prove that all socket outlets and switched socket outlets are connected to the 'live' conductor in the terminal marked as such,

and that each earth pin is bonded to the earth continuity system. Tests shall be carried out to verify the continuity of all conductors of each 'ring' circuit.

Phase tests shall be carried out on completion of the installation to ensure that correct phase sequence is maintained throughout the installation. Triplicate copies of the results of the above tests shall be provided within 14 days of the witnessed tests and the sub-contractor will be required to issue to the service engineer the requisite Certificate upon completion as required by the regulations referred to above.

Any faults; defects. Of omissions or faculty workmanship, incorrectly positioned or installed parts of the installation made apparently by such inspections of tests shall be rectified by the sub-contractor at his own expense.

The sub-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 services engineer to enable him to carry out such tests as he may require.

The sub-contractor shall generally attend on other contractors employed on the project and carry out such electrical tests as may be necessary.

The Sub-contractor shall test to the services engineer's approval and as specified elsewhere in this specification or in standards and regulations already referred to, all equipment, plant and apparatus forming part of the works and before connecting to any power or other supply and settling to work.

Where such equipment, etc., forms part of or is connected to a system whether primarily of n electrical nature or otherwise (e.g. air conditioning system) the sub-contractor shall attend on and assist in balancing, regulations testing and commissioning, or if primarily an electrical or other system forming part of the works, shall balance, regulate, test and commission the system to the service engineer's approval.

21.0 SOLAR INSTALLATIONS

21.0 SOLAR INSTALLATIONS

21.1.0 EXTENT OF WORKS

The contract works shall comprise the supply to site, storage, replacement of breakage, hoisting, cleaning, installations, connection, testing, commissioning and guarantee and maintenance during defects liability period of the solar electrical installation services as described in this specification and on contract drawings and to the satisfaction of the Engineer and Architect.

21.2.0 MODULE SUPPORTING STRUCTURES

Each module supporting structure shall be made of pure aluminium parts.

All these aluminium parts shall be jointed to approval, and the structure shall be able to withstand 25kg. weight or three times, the weight of the installed module, whichever is heavier.

The module shall be supported at 15° angle to allow self cleansing.

The structure (module) shall be installed at any suitable position of the roof, determined on site. The tenderer must allow for this flexibility

21.3.0 SOLAR MODULES

Each solar module shall be manufactured to give a minimum of 40 watts peak power, and be capable of charging 12-volt 100AH battery through a charge controller.

Each module shall have sufficient means of providing shock resistance, and overheating due to localised shading.

21.4.0 BATTERY AND CONTROL UNIT BOXES

Battery boxes and electronic control unit boxes shall be made from 20mm. thick camphor wood, or the approved equivalent, with three layers of varnishing. Sufficient ventilation shall be provided to approval.

The whole top part of the box shall be hinged and lockable with cover of the same wood material.

Each internal dimension of each type of box shall be 100mm. longer than that of the battery itself.

Boxes shall be supported by horizontal and parallel wall mounted steel bars provided by the builder.

Each box shall have 4 No. semi-circular sandles at the bottom for this bar supporting.

Battery boxes shall be installed 100mm. away from control unit boxes.

Jointing and finishing of all boxes shall be done to approval.

21.5.0 BATTERIES

Every battery shall be 12 volt deep cycle maintenance free photo voltaic type lead acid, capable of storing 100 Amp-hours and manufactured to the relevant British or Kenya Standards.The battery shall be capable of being charged by a 40 watt peak power solar module, and shall be completely maintenance free.

21.6.0 CHARGE CONTROLLER

All charge controllers shall prevent any damage to the batteries. The controllers shall consist of series relay battery charge regulator, with low voltage load disconnect, a load fuse and status light indicator.

Each charge controller shall provide a minimum of the following functions;

a). Charge regulation;
b). Maximum module usage;
c). Current compensated low voltage load disconnect;
d). Load fuse;
e). Status lights;
f). Input noise suppression;
g). Reverse leakage protection;
h). Lightning protection;
i). Central wiring.

21.7.0 LIGHT FITTINGS

Ceiling suspended light fittings shall be installed, by means of chains supported by holes in metal or timber purlins. It shall be the sub-contractor's responsibility to drill these holes. These shall be connected to a ceiling box by flexible cord. Each fitting shall have its own home made lampshade supplied by the client. The tenderer must allow in this price for the fitting, collection, transportation and installation of the lampshade.

21.8.0 INSTALLATIONS DETAILS

Modules, batteries and control units shall be interconnected by 10mm squared single core copper cables installed in waterproof terminated flexible 25mm steel conduits. All conductor terminations shall be done by means of purpose made copper terminals of the right size, to approval.

Flexible steel conduits shall be fixed on purlins and walls by means of stainless steel sandles, spaced at 500mm intervals. Steel conduits shall hide all cables completely.

All sub-circuit wiring shall be done by means of 2.5mm squared single core copper cables, installed in white P.V.C. (25 X 12) mm section mini-trucking along and through the walls, and steel conduits along the Purlins (i.e. for ceiling fittings only).

3 No. 15 Amp switches shall be installed (mounted) inside the control unit, for isolating the load, battery and module respectively.

No two or more switches and no two or more lighting fittings shall share one 2.5mm squared conductor, unless otherwise stated in the contract drawings.

The sub-contractor shall provide approved means of connecting all the load conductors to their 15 Amp switch.

21.9.0 CONDUITS, CABLES AND SWITCHES

Conduits, cables, switches and any other part of the electrical installations, shall meet the requirements given in general specifications (section 2 of this specifications).

21.10.0 RECORD DRAWINGS, MANUALS, INSTRUCTIONS AND TRAINING

The Sub-Contractor shall produce three accurate sets of drawings, detailing all the final solar electrical installations and manuals for maintaining and using the modules, batteries, charge controllers, lighting fittings and all other parts of the installations. He shall also train two persons in the materials suppliers' workshop. The training course shall cover maintenance of all the provided solar installations. The tenderer must state the training period.

B. PARTICULAR SPECIFICATIONS FOR ELECTRICAL AND MECHANICAL INSTALLATIONS

22.0 PARTICULAR SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

22.1 GENERAL

This section specifies the requirements for plant, equipment and materials forming part of the electrical works of the Contract, and shall apply except where otherwise specified.

Where the word 'Engineer' is used in these descriptions of Materials and Workmanship, it shall in all appropriate cases be used and construed as the 'Electrical Engineer'.

The whole of the electrical work is to be executed by suitably qualified and experienced operatives, and skilled tradesmen employed by the Contractor or by Sub-Contractor and are all to be specifically approved of by the Engineer. All workmanship shall be of good standard and in accordance with the acceptable practices and the relevant Codes of Practice.

22.1.1 Regulations

The Contract works must be carried out strictly in accordance with the following documents:-

i) The current version of the sixteenth edition of the 'Regulations for Electrical Installations' published by the Institution of Electrical Engineers, London (with local amendments, where applicable).

ii) Local Burundi & Tanzania laws and by-laws and Supply and Local Authority requirements.

iii) Relevant British Standard Specifications and Codes of Practice, published by the British Standards Institution (hereafter referred to as B.S. and C.P. respectively) as implemented in Burundi & Tanzania.

iv) The Specification.

v) Any working drawings produced by the Contractor and approved by the Engineer.

vi) The Engineer's instructions, drawings and details.

The Contractor shall undertake all modifications demanded by the authorities in order to comply with the regulations, and produce all certificates, if any, from the authorities without extra charge.

22.1.2 Quality of materials and manufacturing standards

Notwithstanding that suppliers may have been named or approved by the Engineer, it shall be the Contractor's responsibility to ensure that all materials and components are up to Specification in respect of manufacture, finish and performance.

Named manufacturers are those on which the design has been based and whose standards of products are approved and intended only as a guide to the Contractor.

All materials shall be suitable for their intended use and shall comply with relevant Standards and be installed in accordance with Codes of Practice, manufacturer's recommendations and the Specification.

Materials and/or apparatus supplied by others for installation and/or connection by the Contractor shall be carefully examined on receipt. Should any defects be noted, the Contractor shall notify the Engineer immediately.

Unless otherwise specified, all materials including equipment, fittings, cables etc., shall be in new condition. Defective equipment or that damaged in course of installation or test shall be replaced or repaired to the approval of the Engineer. Should any replacement, be necessary, the Contractor shall bear the cost of substitution and of all associated builder's work and making good finishes.

All materials to be used shall be fixed or applied in accordance with the manufacturer's instructions.

22.1.3 Installation requirements

It is necessary that all the Contractor's proposals and working drawings for and in connection with the electrical works shall be submitted early in the Contract period to facilitate co-ordination with others.

The Engineer reserves the right to call for samples of some or all materials and products to be used.

The contractor shall obtain such samples as required and submit them within 14 days and any costs incurred will be presumed to have been allowed for in the tender.

The Contract works shall be of construction, manufacture and finish as to render them suitable for operating throughout their expected life and maintain design conditions. The Contractor shall be deemed to guarantee satisfactory performance of all quoted for items and fixing and operational accessories.

22.1.4 Standards

The Works shall be constructed and tested in conformity with the standards indicated in these specifications. Wherever reference is made in the contract to specific standards and codes to be met by the materials, plant, and other supplies to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the contract. Where such standards are national or relate to a particular country or region, other

authoritative standards which ensure a substantially equal or higher performance than the standards and codes specified shall be accepted subject to the Engineer's prior review and written approval. The alternative standards and codes proposed shall be translated by the Contractor into the English language prior to submission for approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 15 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure substantially equal performance, the Contractor shall comply with the standards specified in the document.

For convenience and for reference purposes, certain equipment, articles, materials, or processes are designated in the specifications by brand name, trade name or catalogue name and number. Such designation shall be deemed, to be followed by the words "or approved alternative" whether such words are shown or not. The Contractor may offer other equipment, articles, materials, or processes which have similar characteristics and which provide performance at substantially equivalent or better than those specified, which will be accepted, subject to the Engineer's prior review and written approval. The burden of providing evidence as to comparative quality and suitability of alternatives shall be upon the Contractor and such evidence must be submitted to the Engineer at least 15 days prior to the date when the Contractor desires approval. No such alternative shall be used without prior written approval by the Engineer."

22.1.5 Record Drawings

The Contractor shall mark accurately on one set of drawings the conduit or trunking laid during the progress of the work. This information must be made available on site for inspection by the Engineer whenever the Engineer asks for it.

At the completion of the contract, the contractor shall supply the Engineer with two soft copies on 3.5 inch floppy diskettes, one set of transparent originals and two complete sets of prints showing the complete installation. The drawings shall include the location of all apparatus, conduit and cable routes and a schematic of mains distribution.

Where portions of the Works are to be concealed, draft copies of " As installed" drawings shall be supplied to the Engineer before the work is concealed in order to facilitate checking and approval.

The Contractor shall maintain on site a set of drawings for the purposes of progressive marking up of alterations and variations. These drawings which shall form the basis for the Record drawings shall be available for inspection by the Engineer from time to time.

A Certificate of Practical Completion will not be issued by the Engineer if the Contractor fails to undertake the above procedure for the preparation of the Record drawings.

Upon the issue of the Certificate of Completion or Making Good of Defects the Contractor shall issue a final set of Record drawings taking into account any changes, which occurred in the Defects Liability Period.

22.1.6 Contract Drawings

The drawings forming part of this specification are to be read in conjunction with this Specification to enable the Contractor to prepare a tender.

These drawings are not intended to be used as working drawings unless they are released for that purpose.

22.1.7 Working Drawings

The Contractor shall prepare working drawings as may be necessary. They shall be submitted to the Engineer for approval before the execution of the works.

Working drawings to be prepared by the Contractor shall be detailed as below but not restricted only to these:-

a) General arrangement drawings showing plant, HV and MV switchboards, distribution boards, consumer units, fittings, switches, switch sockets, etc.

b) Layout drawings of concealed and surface conduit, ducts, trunking, etc.

c) Any other drawings that are not called for in the Specification.

Two copies of all working drawings shall be submitted to the Engineer for approval. Thereafter, the Contractor shall submit copies of approved working drawings for distribution to all parties concerned.
The Contractor shall not be relieved of any of his obligations under the Contract from correcting any errors on site or elsewhere subsequently found in the approved working drawings and no extra financial claims shall be entertained.

22.1.8 Co-ordination of Engineering Services

All aspects of the Engineering Services installation require detailed coordination to avoid any possible clash or conflict with other trades and disciplines.

The Contractor shall undertake such co-ordination in relation to his Co-ordination and Installation drawings and builder's work information and no extra claim will be allowed due to conflict of works or installations.

The Contractor shall initiate all co-ordination meetings that are necessary and all surveys that are necessary.

22.1.9 Labels

All switchgear, switch fuses, distribution boards, etc., shall be clearly labeled with Black and White background engraved labels to indicate the name, purpose and position of the gear. All circuits in distribution boards shall be clearly identified in respect of the number and location of the miniature circuit breakers. The chart shall be securely fixed inside the cover of the distribution boards.

22.1.10 Instruction of Employer's Staff

The Contactor shall be responsible for arranging a Scheme for Instruction and Training of the Employer's Personnel in relation to the Engineering Services.

Draft proposals of the Scheme content shall be submitted to the Engineer for his approval in writing not less than six months before the anticipated date of Practical Completion. Thereafter the proposals will be finalized and a time table shall be provided for the Scheme.

The Contractor is to include for the provision of attendance by himself and by specialist personnel to assist in the training to suit the requirement of the Engineer.

22.1.11 Operating and Maintenance Instruction Manuals

Operating and maintenance manuals shall be provided by the Contractor as detailed in the Specification and Bills of Quantities and as stated below.
A draft copy of the operating and maintenance instruction manuals contained in a temporary loose leaf binder shall be issued prior to the testing and commissioning period for approval of content, layout and form. Once so approved, a draft copy shall be handed over prior to the issue of the Certificate of Practical Completion. This copy shall contain all testing and commissioning data results, actual control setting points and the like in draft form.

Within 28 days of The date of Practical Completion, 2 copies of the final document shall be handed over which shall include all testing and commissioning results and final plant duties and control settings, etc. in an approved form.

22.1.12 Approval/Checking Procedures

All Contractors' Drawings and manufacturers details shall be approved by the Engineer prior to any orders being placed by the Contractor. The final details including all technical aspects and calculations where applicable shall be submitted in a clear, definable and easily read format with the specified technical details, notes and performance data clearly shown in English language.

All correspondence related to the approvals procedure shall be directed to the Engineer through the office of the Architect.

Unless stated otherwise elsewhere the Contractor shall allow 28 working days from the date of receipt by the Architect of the request for Approval of all data and manufacturers details submitted.

22.1.13 Equipment Guarantees

Plant and equipment guarantees shall commence at the date of Practical Completion and run for a minimum of 12 months after this date. Any costs associated with this requirement shall be met by the Contractor.

22.1.14 Plant and Equipment Performance Testing

Major plant and equipment shall be tested at the manufacturers works or in a recognized and approved testing facility to demonstrate performance compliance with the stated and specified duties. Performance testing shall demonstrate but not limited to the following:-

- Full, Partial and Minimum load
- Response to load change
- Efficiency
- Noise levels

The tests shall be conducted to simulate design conditions and all ancillary plant and equipment needed to support the tests together with all instrumentation shall be provided by the Contractor and included in the tender.

Upon successful completion of the performance tests the plant and equipment shall be thoroughly cleaned and returned to its new condition and correctly packaged for delivery to site.

Full test certificate records of the tests shall be issued in duplicate to the Engineer. These tests are in addition to works tests stated elsewhere in the Specification.

The Contractor is to include all costs for the Engineer's attendance at the tests. The Contractor shall notify the Engineer one month in advance of such tests and shall provide within his programme a schedule of works tests visits. The activities to be completed at the visit shall be programmed for approval.

A signed works test document will be submitted to the Engineer on completion of tests before delivery of equipment to site.

22.2 SCOPE OF WORK

The works to be executed under Electrical Installation include the supply on site, storage, installation, keeping clean, protecting, connection, testing and making improvements where necessary, energising, commissioning to the satisfaction of the Engineer and handing over to the Employer in serviceable condition the complete installation as herein specified and measured in the Contract Bills of Quantities or as

may be directed by the Engineer during the course of the works, and shall include all the necessary materials and equipment which although not expressly specified, are necessary for completing the installation. The rates given in the Bills of Quantities for the Electrical Installation shall include all related builders works and materials that are necessary to complete the electrical installation.

The Electrical Installation comprises the following:

a) Securing 3-phase High Voltage Power Supply and Connection complete with Switch Gear and High Voltage Metering unit

b) Supply and installation of 200kVA generator complete with 1600A/415V Automatic Load Transfer Panel.

c) Installation of 200kVA, 415V, 50Hz DYn 11 Pole mounted outdoor Transformer having +-2 x 2.5% Tapping Range indoor Transformer with other attachments and accessories both as to ABB manufacture or approved equivalent.

d) Installation of LV Main Feeder Pillar, LV Sub-Main Feeder Pillar, Distribution Boards, Consumer Units and Cables as per drawings.

e) Internal and External Lighting Installations.

f) Small Power Installation. The small Power installation shall be carried out as per the drawings.

g) Lightning Protection Scheme

h) Mains System Earthing

i) Builders Works and making good to the satisfaction of the Engineer.

j) Related Builders Works

22.3 POWER SUPPLY

3.1 Proposed Mains Power Supply

Proposed power supply to the Site shall include mains extension of TANESCO overhead high voltage line through a high voltage switch gear and high voltage metering unit installed at Kabanga, Tanzania, the originating point of the Power Line, to the site and installation of a 200kVA Transformer for the entire premises.

3.2 Mains Distribution

From the Distribution Boards and Consumer Units, all power distribution cables shall be installed in conduits as specified and agreed with the Supervising Engineer, to all installed loads located within the building.

22. 4. LOW VOLTAGE FEEDER PILLARS, DISTRIBUTION BOARDS AND CONSUMER UNITS

4.1 Low Voltage Switchgear Standards

The transformer and generator shall supply 415/240 Volts Low Voltage supplies to the low voltage switchgear.

All switchboards shall have a minimum fault capacity of 50kA for one second.

The switchboards for the control of equipment rated 415 Volts shall comply in all respects with BS 5486 (IEC 439), BS 5227, BS 7354, BS 88, BS 5424, BS 7340.

4.2 General Requirements for Switchboards

The main low voltage switchboards shall be of modular cubicle pattern, extensible from both ends, of folded sheet steel construction, and floor standing with operation and switch access from the front and cabling access from the rear. The switchboards shall have fully compartmentalized interior sections with withdrawable switchgear and control gear assemblies, with the design based on IEC 439-1 and related international standards. The Feeder Pillars shall be designed for conductor entry from bottom, unless otherwise required.

All switchgear, distribution boards, motor control centres, and other panels shall comprise factory built assemblies of the multi-cubicle type. Each air circuit breaker, fuse switch, busbar, instrumentation and protective relaying section indicated on the drawing shall be housed in a separate compartment with an individual cover, fully divided from adjacent compartments by the sheet metal housing; circuit interconnection, etc, penetrations shall be contained within ductings or shrouded around. The entire switchboard shall be of fully shrouded type. The busbars shall be coloured according to phase. All equipment shall have fully shrouded fixed contacts and connection terminals, such that contact with adjacent live metal is impossible when working on individual units. All sections of the board shall be suitable for safe, effective working, for maintenance, cable removal and installation, etc., with the switchboard live and without shutting down adjacent sections.

Panels shall be free standing, of uniform height, flush mounted and totally enclosed to not less than IP 31. When size of starters and other components does not justify this type of construction, wall mounted patterns may be used.

The base of the panel shall be effectively sealed against the ingress of vermin and termites, and all equipment shall be rated for continuous operation in a tropical climate.

Any ventilation louvres shall be backed by brass fine mesh gauze to exclude termites.

Framework for the panels shall be of welded construction, and panels shall be fabricated from mild steel sheet of 2mm minimum thickness, folded and braced where necessary to provide a rigid structure.

All bolts, nuts, screws, hinges, handles, etc, shall be corrosion resistant.

Interiors shall be finished white, and the exterior shall be finished to a light grey shade except the plinth, which shall be black.

Cabling access shall be from the rear by means of gasketed bolt-on plates, which shall be fitted with handles to facilitate removal/replacement.

Access to the cubicles or cubicle compartments for all normal routine maintenance shall be from front with hinged and lockable doors fitted with neoprene gaskets (all gaskets shall be termite resistant) and chromium plated lockable tee type handles. All doors shall be electrically bonded to the main frame, using adequate flexible conductors, protected against mechanical damage. All locks on a given panel unit shall be operated by the same key.

Each multi-compartment control panel shall comprise an assembly of individually constructed cubicles. These shall be assembled to include a metallic sheet between adjacent cubicles.

In each multi-compartment panel at least one empty compartment shall be provided for future use. In single unit panels, enough space shall be available for the addition of at least 10% more components for future use.

Panels shall be readily capable of extension at either end, within the bus-bar rating.

Where panel size is excessive, easily handled sections shall be supplied for site assembly. Sections shall be fitted with eyebolts, which after positioning of the panel, shall be removed and replaced with plated bolts and washers.

Bases shall be of rigid construction capable of withstanding stresses during replacement, such as those imposed by moving the sections on rollers.

4.2.1 Bus-bars

All bus-bars shall be of electro tinned HDHC copper, and shall be of uniform section throughout the length of the panel.

They shall be run in a separate screened compartment, divided with barriers into as many compartments as there are cubicles in the panel. Access to individual compartments shall be via bolt-on cover plates, each bearing the legend in white on a red background:-

"DANGER - LIVE BUS-BARS", also the Red Arrow symbol denoting danger from electric shock

The neutral bus-bar shall be equal to the cross-sectional area of the phase bars. Phase bars shall be colour coded Red, Yellow and Blue: the neutral shall be black.

4.2.2 Over and under-voltage, phase failure and phase sequence protection

The main incoming 415 volt switchboards and control panels shall be equipped with a relay which detects un-acceptably high or low voltage.

It will monitor all phases and will cause all incoming circuit breaker(s) to trip when the voltage exceeds a maximum or minimum (which shall be selected from a range of settings). Visual indication shall be given of the cause of tripping and an electrical hours counter will record the time during which the supply exceeds the set limits.

Resetting of the relay shall be automatic but re-closure of the tripped circuit breaker shall be manual.
It shall be possible to delay the operation of the relay in order to ride through transient voltage variations.

Phase failure shall cause the circuit breaker to trip immediately and incorrect phase sequence will prevent the circuit breaker from being closed.
The Lovato Electronic Voltmeter Relay type RVT manufactured by the Officine Electtromeccanica Lovato of Italy meets the requirements for this application. Alternatives may be offered for the approval of the Engineer.

4.2.3 Surge Voltage Protection

In order to give protection against transient over-voltages or voltage surges such as result from lightning strike, surge arresters shall be installed on the 415 volt bus-bar of the main LV panel.

They shall be connected permanently between each phase and earth and shall be as near as possible to the incoming circuit breakers.

Each unit shall be sealed and encapsulated with connecting tails and be suitable for continuous operation at 415 volts. It shall also comply with the class 2.5KA requirements according to IEC 99.

All solid state control or electronic devices which may be located within the panel shall be individually protected by surge arresters.

4.2.4 Terminals

Terminal board insulation shall be polyamide or equivalent. Melamine types are not acceptable.

All connectors shall be of brass or bronze, with screw of similar material. Contact between dissimilar metals is not acceptable. No steel screws plated or otherwise shall be used. Insulating barriers shall be fitted between supplies at different voltages.

All terminal screws shall be captive.

Terminals shall be mounted at least 250mm above their associated gland plates.

Only one conductor shall be connected to each terminal. Multiple connections shall be effected using links.

Main power terminals shall be stud and nut types, with plain and locking washers. Conductors terminating on these shall be fitted with insulated crimped lugs. Rail mounted terminals for cables in excess of 32mm sq. cross-sectional area is not acceptable.

4.2.5 Gland Plates

Adequately sized blank gland plates shall be provided below each outgoing terminal section to accommodate the requisite glands.

Gland plates shall be positioned 200mm minimum above the base of the cubicle, and shall be solidly bonded to earth.

Suitably sized compression type cable glands shall be provided for all cables. Glands used for armoured cables shall include provision for sealing the armour wires to protect them from corrosion and to prevent ingress of moisture into the cable.

Brass lugs shall be provided for connection of the cable armouring to earth.

4.3 Distribution Boards

The Distribution Board is an MCB-type, and shall be supplied at 415Volts, 3 phases from the existing Main Low Voltage Switchboard located at the Main Load Centre house.

General lighting and power distribution boards shall comply with BS 3817, BS 5861 and BS 5486 and shall be of the metal clad pattern, flush mounted except where otherwise specified on the drawings or Bills of Quantities.

4.3.1 Construction

Enclosures shall be substantially constructed from 16SWG minimum thickness sheet steel having hinged front cover and shall be vermin and insect proof. Each unit shall house MCBs and shall be supplied complete with bus-bars, earthing terminal, neutral bar, circuit chart and any blanking plate for any spare ways. The incoming isolator switch shall be integral with the distribution board in consumer's units only, or as may specifically be requested for. The distribution boards shall be lockable by key.

4.3.2 Mounting

All distribution boards and consumer units shall, unless detailed to the contrary, be mounted with the lower edge 1800 mm from the finished floor level.

Notwithstanding the above, generally, switchboards and distribution boards shall be installed so that any item to which easy access is required such as fuse, circuit breaker, instrument, etc is not more than 2150 mm above finish floor level.

Isolators, switch fuses (other than those mounted on bus-bar chambers or providing local control), cooker control units, water heater controls, etc, shall on the other hand, unless otherwise stated on the drawings, be mounted at 1350mm from the finished floor level to the underside of the fittings.

4.3.3 Miniature Circuit Breakers

All distribution boards shall be supplied with MCBs manufactured to BS 3871 and of a rating as specified on the drawings. The circuit breakers shall incorporate both terminal overload and magnetic short circuit tripping, with a trip-free mechanism.

Three phase circuits shall be controlled by integrally manufactured three pole breakers, with one common operating lever. An inter-tripping mechanism shall ensure isolation of all three poles in the event of an overload or short circuit on any one phase.

22.5. CABLES

All cables shall be BASEC approved. P.V.C. insulated cables shall be 500V/1000V grade to B.S. 6004. Flexible cables shall be 300V/500V grade to B.S. 6500.

No cables forming sub-circuits connected to different sub-distribution boards are to be drawn into the same conduit or draw-in box.

No reduction of the strands forming the conductors will be allowed at switch or other terminals, but all strands shall be efficiently secured by screws, nuts and washers or other approved means.

Cables may be jointed together at the terminals of ceiling roses and other accessories. Under no circumstances will joints be permitted in the run of the cable.

All cables shall be of stranded copper conductors.

The minimum size of cables on lighting and power final sub-circuits shall be 1.5mm sq. for lighting and 2.5mm sq. for power.

5.1 PVC Insulated Armoured Cables

These shall be 500/1000V grade to BS 6346 and BS 6004 having stranded copper conductors, armoured and PVC sheathed overall. The cores of four core cables shall be distinctively coloured red, yellow, blue and black.

5.2 XLPE Insulated P.V.C. Sheathed Armoured Cables

XLPE insulated P.V.C. bedded galvanized steel wire armoured and P.V.C. overall sheathed twin and multicore cables shall have stranded copper conductors, and shall be 600/1000V grade manufactured in accordance with B.S. 5467. This type of case shall generally be treated in a manner similar to that for P.V.C. insulated and sheathed cables.

The Contractor shall provide suitable glands and accessories for all armoured cable terminations and the cost of these items shall be included within the rates inserted in the Bills of Quantities.

5.3 Installation

5.3.1 Laying of Cables

The work of excavating and back-filling of all trenches for cables is included in this contract and the responsibility for positioning, width and depth of trenches, laying and bedding of all cables and protective covers is included with the Electrical Works covered by this Specification. Unless otherwise stated, all underground cables shall be laid in uPVC conduits with draw pits as shall be indicated on the drawings or as may be required by the Site conditions. The uPVC pipes shall be laid to a minimum of 750mm below ground. The uPVC ducts shall be sand bedded to a depth of 50mm below and above the pipe. The rates inserted for uPVC pipes shall included the costs of sand bedding.

In case it is required to lay cables direct in ground, the following shall apply:-

Where more than one cable is laid in a trench, cables shall be spaced as follows:-

Between MV cables	100mm
Between MV and telephone cables	400mm
Between MV and LV cables	400mm
Between LV and telephone cables	400mm
Between LV cables	100mm

In straight run trenches, cable crossings shall not be permitted except where a cable branches from the main run.

At every draw-in point, joint or junction box, the cable should be snaked.

Before cables are laid, the bottom of the trench shall be evenly graded and cleared of all loose stones and shall then be covered with an 80mm layer of sand or sifted soil and lightly compacted. A further 80mm layer shall be placed on top of the cables.

The approved cable protection shall then be laid and the trench refilled with excavated materials in 200mm layers, each layer being well compacted by hand or mechanical punners before the next layer is filled.

The width of the trench shall be such that a clearance of 80mm shall be provided between the outermost cable and the side of the trench.

Where cables are disposed in more than one layer, the vertical spacing shall be 400mm between centres of cables or cable groups the depth of the trench being made suitable accordingly. Stones or other hard objects shall not be included in any of the backfilling materials.

In the laying of cables in the uPVC ducts, the internal radius of bends shall be six times the overall cable diameter.

The rates inserted for cables shall be deemed to include for the above requirements.

5.3.2 Protective Covers

The protective covers, manufactured in accordance with BS 2484 shall be provided over cables laid in the ground, each complete with an interlocking device to prevent lateral displacement. The rates inserted for cables shall be deemed to include for the protective covers.

5.3.3 Cable Position Markers

These should be placed adjacent to all points where cables change direction and all intervals of not more than 30 metres and at other positions designated by the Engineer.

5.3.4 Sealing of Cable Entries

Where cables enter buildings, pipes, or ducts, the mouths of the pipes or ducts shall be effectively sealed by means of close fitting solignum impregnated wooden plugs and a mixture of compound and transformer oil, or other approved manner.

5.3.5 Protection Against Mechanical Damages

All cables located in such positions where they are vulnerable to damage by mechanical or other means shall be protected by suitable lengths of steel pipe bushed to prevent damage to the cable.

5.3.6 Rating Plates

Each cable when completely erected shall have permanently attached to it at each end in such intermediate positions as may be considered necessary by the Engineer, metal plates upon which is engraved, or stamped, the identification number of cable together with the voltage, size and make-up, and the service which it supplies.

This information shall be recorded by the contractor so that it may appear on drawings of the completed installation.

5.3.7 Cable Sealing and Termination

The contractor shall be wholly responsible for the sealing and jointing of all cables supplied and erected under the contract.

The cable boxes, looping-boxes and glands for LV cables on all items of equipment shall be provided under the contract.

Sealing and jointing shall be in accordance with the best current practice and of first class workmanship. Where cable armouring is used as earth continuity

conductor, the glands shall have the necessary contact surface or provide a low resistance path under fault conditions.

The tender shall include for all cable jointing where appropriate and all labour, joining material and compound, together with the use of all jointers' tools and making off the cable tails to the apparatus terminals.

5.3.8 Cabling Details

The contractor shall submit a schedule of all cables, detailing the following for each cable proposed:-

a) Reference Number
b) Type
c) Cross Sectional Area
d) Number of Cores
e) Origin
f) Destination
g) Cost per metre installed
h) Cost for each termination (glanding and making off)
i) Route Length
j) Operating Voltage
k) Estimated Current
l) Percentage Volt Drop

Rates (g) and (h) shall be used to assess costs in the event of any agreed route length variation.

The Contract Price shall include all cables required for a fully operational installation and for laying all the cables in accordance with the requirements in Section 5.3 of this Specification.

22. 6. WIRING ACCESSORIES

6.1 Non-metallic conduit

All non-metallic conduits shall be class "A" heavy gauge, high impact PVC complying with BS 4606 Part 2, type AH.

The minimum size to be on the contract is 20mm external diameter. All conduit installations shall be concealed in the walls and floors or in structural slabs.

Conduits shall be kept at least 150 mm clear of gas piping and colour coded orange when required.

Conduits shall be kept at least 150 mm clear of steam and hot water systems and preferably beneath the aforementioned services.

Conduit runs shall be complete before wiring is begun and shall not be dismantled for wiring operations.

Conduit used in flameproof installations shall be of the solid drawn type.

6.1.1 Bends

Bends and sets in the conduit will be made in accordance with the manufacturer's instructions. The radius of the bend shall not be less 2.5 times the outside diameter of the conduit, or such greater radius which will facilitate easy drawing in of cables.

All conduit bends are to be made on site and not more than two right angle bends will be permitted without the interposition of a draw box.

6.1.2 Expansion

Adequate allowance shall be made for longitudinal expansion and contraction of the conduit under normal working temperature variations as follows:-

a) Expansion couplers should be used in straight runs exceeding 6 metres with a loose or flexible type joint at the long spout end of the coupler.

b) Saddles as supplied by the manufacturers shall include a sliding support tolerance for longitudinal expansion.

c) Saddles shall be installed within 300mm either side of conduit boxes where the free length of conduit exceeds this distance.

d) Multiple saddles shall be used where two or more surface conduits run parallel and adjacent to each other.

e) Special consideration may need to be given to the fixing of accessories where this may prevent natural conduit movements. Oversize or slotted fixing holes may be necessary or introduction of expansion couplers.

6.1.3 Conduit Boxes and Fittings

a) All conduit boxes shall be circular or square pattern of rigid PVC suitable for plan connections conforming to sheet 62 BS 4606, Part 2. Boxes supporting a fitting or accessory shall be fitted with a PVC lid held in position by means of two 2BA round headed screws. Boxes shall have metallic screwed inserts.

b) Circular or square boxes shall be provided at all outlet points, unless otherwise specified; lighting fittings, ceiling fittings, ceiling switches and other accessories will be screwed to the internal lugs of the boxes.

Care must always be taken when considering the use of totally enclosed fittings with PVC circular boxes where the temperature within the box is likely to rise above 60 deg. C (140 deg. F). In this case, special steel insert clips should be used in conjunction with circular boxes where this problem can arise and also in situations where heavy pendants are used.

c) Looping in boxes of circular PVC pattern to sheet 63 BS 4607 Part 2 may be used in such work as dictated by the structure of the buildings. Conduit entry shall be made by means of PVC bushes.

d) Adaptable boxes shall be of moulded or fabricated PVC of square or oblong shape complete with PVC lids secured by 2BA brass or steel plated round-headed screws. All adaptable boxes and lids of the same size shall be interchangeable. No adaptable box smaller than 75mmx50mm or larger than 300mmx300mm shall be employed. Boxes shall be of adequate depth in relation to the size of conduit entering them.

e) Conduits shall be terminated at adaptable boxes; fuseboards, switches, sockets or other equipment possessing push-in or threaded spouts, by means of appropriate size female adaptor and PVC hexagonal headed male bush. All cemented joints to be made to a depth of not less than the diameter of the conduit being used.

6.1.4 Earth Continuity

Earth continuity shall be provided by a separate insulated conductor drawn into the plastic conduit and rated in accordance with circuit loadings and appropriate Regulations or as mentioned on the drawings.

Where required under the regulations and earth continuity conductor shall be provided for lighting fittings in which case the control switches shall be equipped with an appropriate earth terminal.

6.1.5 Arrangement of Conduit Layout

The conduit system shall be carefully planned and erected to avoid all unnecessary bends or changes in direction. Conduits shall be laid in straight horizontal or vertical lines with easy sets. Where several conduits follow similar routes, they shall be neatly grouped in multiple runs. Where multiple runs change directions, the radii of the sets shall be laid out from a common

centre. Where draw-in boxes for right angled change of direction are required in multiple runs, adaptable boxes shall be used for such sizes as to allow all conduits to enter the box with sets.

Where conduits are concealed or laid on structural floors, they shall be secured by a fixed method to be approved by the Engineer. Where it is essential that conduits cross one another in floors, the chases shall be deepened and the conduits set to create the minimum desirable diversion.

Care shall be taken to ensure that there is no obstruction to cables within the conduits caused by the ingress of plaster, concrete or other matter. Conduit ends must be cut square and cleaned of burrs.

6.2 Final Sub-circuit wiring

All power and lighting wiring cables shall be 600/1000V grade, single core PVC insulated, with stranded copper conductors in accordance with BS 6004. The minimum sizes of lighting circuits shall be 1.5mm sq; and ring main circuits shall be 2.5mm sq.

Installation

No reduction of the strands forming the conductors shall be allowed at switch or other terminal, but all strands shall be effectively secured by screws, nuts and washers or other approved means.

Cables shall be joined together at the terminals of ceiling boxes and other accessories. Under no circumstances will joints be permitted in the run of the cable.

6.2.1 Socket Outlets

In all areas, general power outlets shall be of the 13A 3-pin fused plug type complying with BS 1363. They shall be flush pattern, with white or ivory cover plates unless otherwise specified on the drawings. Where the circuits are supplied from a common feed, two outlets shall form a twin unit in a common box. The earthing terminal of every socket outlet shall be connected to the earth continuity conductor of the final sub-circuit by an appropriately sized insulated copper conductor. Unless otherwise stated they shall be mounted at 300mm above the finished floor level or 200 mm above the worktop.

6.2.2 Telephone Outlets

These shall be of the type as specified in the Bills of Quantities, or in the particular specification for telephone work. Unless otherwise specified they shall be mounted at 300mm above the finished floor level or 200 above worktop.

6.2.3 Fused connection units

All fused connection units shall be of the 13A type with fuse and neon indicator lamp. Boxes shall be flush type with white or ivory cover plates and shall be switched type unless otherwise specified on the drawing.

6.2.4 Fuses

All fused connection units shall be fitted with 13A fuses, unless otherwise specified.

6.2.5 Labeling

The front plates of each fused connection unit shall, unless otherwise specified, be engraved with the name of the appliance connected to it.

6.2.6 Lighting Switches

Lighting switches, unless specified otherwise in the Bills of Quantities, shall be of the all-insulated rocker-operating plate-switch type to BS 3676, and shall be of ample rating. Switch inserts shall be white with ivory cover plates.

Switches controlling points in bathrooms shall be placed outside the bathroom, or consist of a ceiling switch operated by a non-conducting cord, as specified. Switches mounted outdoors shall be of a weather tight pattern.

All flush or surface installed switches shall, unless otherwise specified, be mounted at a distance of 1350mm above finished floor level.

Ceiling switches shall on the other hand be positioned at not less than 300mm from the point which they control.

Switches shall be one-way, two-way or intermediate and where a number of switches are mounted together, they shall be fitted in a common box. All lighting switches shall be connected only in the phase line of all circuits.

6.2.7 Lamp Holders

Lamp holders shall generally be of plastic construction with porcelain interiors and bayonet fitting.

Lamp holders for lamps rated 200W and above shall be of the Edison Screw type.

Batten type lamp holders shall be of the all-insulated bayonet type.

6.2.8 3-Phase plugs and sockets

The plugs and sockets shall be 5-pin suitable for 415 volts, 3-phase, 50 Hz with separate neutral and earth pins. They shall comply with BS 4343 and IEC 309 and be protected to IP 44 or better.

The plugs shall be of polycarbonate material but the sockets shall be of aluminium alloy, suitable for conduit connections. The socket shall be surface mounted at a height of 1.25m AFL.

6.2.9 Consumer Units

All consumer units shall be miniature circuit breaker type for flush mounting as specified in the Bills of Quantities. Covers shall be lockable to restrict removal of the miniature circuit breakers. The boards shall be modular type allowing easy rail mounting of other components such as time switches, contactors, etc. without modification.

Cable entry shall be possible from both top and bottom.

6.2.10 Sub main Power Distribution

Sub-main cables will distribute power from the main switchboards and from the sub-main boards to the consumer units.

Cables shall be routed as per drawings or Engineer's instructions on site. But allowance for cable passage (pipes or ducts, etc) shall be put in place at the earliest possible stage of construction to avoid having to cut walls, floors, roads etc.

6.2.11 Power Installation

All power installations shall be concealed in floors, walls and in space above the false ceiling. However, in offices power installations shall be in metallic trunking mounted at windowsill level, unless otherwise specified in the Bills of Quantities.

Unless indicated otherwise the following installation heights shall be used:

Power outlets at 300mm above finished floor level (AFFL)

Socket outlets at 300mm AFFL

Isolators for various equipment at 1350mm AFFL

6.2.12 Lighting Installation (Internal)

All lighting installations shall be concealed in the walls, space above the ceiling and in floors.

All light fittings shall be as specified under individual items of the Bills of Quantities. All fittings shall be complete with all the necessary accessories for proper fixing or mounting.

All light switches shall be installed 1350 mm AFFL

6.2.13 Cables and Wires

All cables and wires to be used in the Electrical Installation shall be of stranded copper conductors.

All cables for outdoor installation as well as sub-main cables installed indoors shall be XLPE-SWA-PVC or PVC-SWA-PVC as specified in the Bills of Quantities. Proper glands shall be used for termination.

Unless specifically indicated otherwise, no conductors smaller than 1.5mm^2 shall be used for any purpose.

All conductors for ring main circuits shall not be less than 2.5mm^2.

Generally, sizes of conductors for the various circuits will be shown on circuit drawings.

6.2.14 Fixing/Mounting of Accessories, Fittings, etc

All screws, brackets, saddles, etc used for fixings shall be of galvanized steel or other non-rusting material of equal strength.

Switchboards, distribution boards, consumer units and all other items of excessive weight or subject to heavy use, shall be fixed with properly sized non-rusting expansion bolts.

22. 7 LIGHTNING PROTECTION

Lightning protection systems in accordance with the requirements of BS 6651/1992 shall be installed. This shall incorporate air terminals down conductors and an earth terminal.

Lightning protection installation shall, in general, consist of copper or aluminium tapes of 25mm x 3mm section with similar clips, test clamps and copper bond earth rods, which shall be mounted in positions in conformance to the 16th edition of the IEE Regulations and as per Standard Code of Practice.

Earth roof tape shall be provided with a similar copper or aluminium down tape to the earth test position and from the earth test position to the earth electrodes enclosed in concrete earth pits.

The earth resistance of the completed system shall in no circumstance exceed 10 ohms. If this value cannot be obtained by means of a single earth electrode, extra rods may be used in parallel and the Contractor should provide for such an eventuality when pricing.

22.8. EARTHING

8.1 General Installation Earthing

a) Earth electrodes shall be minimum 1200mm long by 15mm diameter hard drawn copper rod, and shall be located at a convenient position as close as possible to the building. The terminal head of each electrode shall be in a concrete inspection pit, with cover. If the resistance to earth is not satisfactory with one electrode, then additional electrodes or an earth mat shall be provided as directed by the Engineer.

b) Particular attention should be given to conduit and trunking installations to ensure that the earth continuity is reliable and permanent.

c) All apparatus or parts thereof not solidly connected to the earthing system shall be connected thereto in an approved manner by solid copper conductors secured by means of substantial bonding clamps.

d) All services entering the installation at earth potential shall be efficiently bonded to the main earth point.

e) All joints in the earth system shall be made with solder less connectors, or by an approved brazing method.

f) The resistance of the earth continuity system when measured between the main earth point and any other point in the installation, including all metalwork, which may provide a path to earth, such as gas, water pipes, etc, shall not exceed 0.5 ohms.

g) All flexible metallic tubing shall have a bare earth conductor run with the tubing, the ends being securely bonded. The size of the earth conductor shall be as indicated in the current edition of the IEE Regulations.

h) Care should be taken that the neutral conductor does not become accidentally earthed.

i) In accordance with the UEDCL's procedure of multiple neutral earthing, the neutral of the supply is to be bonded to the earth pipe. The mechanics of bonding will be performed by an official of the UEDCL.

j) Earthing shall conform to the 16th edition of the IEE Regulations.

8.2 Distribution System Earthing

All distribution boards shall be earthed in accordance with the IEE Regulations. All metalwork associated with the installation shall be earthed to comply with the Regulations currently in force.

22. 9 STANDBY GENERATOR SET

There will be a 200kVA / 415V / 50Hz standby generator permanently installed to provide part of the electricity requirements of the project in case of mains failure however the client may opt to supply it.

Incoming circuit breakers shall be included in the 415 V Main Low Voltage Feeder Pillar and shall be mechanically interlocked with the circuit breakers for the TANESCO mains supply, so that both supplies cannot be connected simultaneously.

9.1 Particular Specification for the Generator Set

Scope

Supply and transport to site as indicated in the drawings. Install and commission the generator sets as per Specification here-below. All ratings are for 40 deg C ambient temperature, 1312 metres altitude above sea level and 66% average relative humidity in accordance with BS 5514. The tenderer shall also state the applicable warranty period for parts and labour.

Engine

Radiator cooled heavy duty diesel continuously rated to BS 5514 with sufficient power capacity to supply 10% over base load in one hour in every twelve hours.

Cooling Radiator

Tropical capacity with engine driven fan complete with protection guards. Radiator shall cool the engine at rated output in ambient temperature up to 52 deg. C.

Engine Filtration

Air - Heavy duty dry type filters with replaceable elements.

Fuel - Filter with replaceable element

Lubrication - Oil filter with replaceable element

Engine Protection

Emergency automatic shutdown facilities for:-

(a) Low oil pressure

(b) High water temperature

(c) High oil temperature

(d) Low radiator water level

Heavy duty residential type exhaust silencer system for installation on site. Noise level better than 40dB (A) at 20m from the generator set. 12/24V starting system complete with high capacity lead acid starting batteries rack mounted on machine base frame, heavy duty interconnecting cables with terminals and direct battery charging system.

Coupling Arrangement

Main drive flexible coupling with flange coupling of engine and alternator

Base

Generator set and radiator to be mounted on fabricated base frame with a diesel tank, anti-vibration mounting pads positioned between the set and the base frame.

Diesel tank

To be of sufficient capacity for at least 8 hours continuous operation at rated output. Fittings to include fuel fill point, fuel gauge, breather, drain plug and flexible fuel lines.

Alternator

Brush less, revolving field, self regulating, self exiting, screen protected, foot mounted, with grease lubricated end shield bearings continuously rated as specified in the Bills of Quantities, with over load (standby) capacity of at least 10% for one hour in twelve to IEC 34-1, BS 5000, BS 4999/40.

Voltage Regulation

By Automatic Voltage Control via main exciter with a regulation of +/- 1.5% for 0.8 power factor up to unity power factor loads, and 5% speed variations.

Automatic Mains Failure Control

Mains voltage sensing relay with mechanical-electrical interlock changeover MCCBs of appropriate rating. Constant voltage battery charger with charge rate ammeter.

Adjustable timers for engine start/engine stop/ load transfer and 3 attempt start to allow for normal fluctuations in supply.

Duty select switch: Off/manual/auto/test indicating lamps for mains on load/generator on load/mains available. Voltmeter with single or multi-position selection switch as applicable.

3 ammeters

50Hz frequency meter (suitably sealed)
Individual fault indication lights

Battery condition indicator

Hours run recorder

Installation

The price shall include for installation and commissioning complete and ready including installation and maintenance tools and manuals.

Documentation

Operation and Maintenance manuals for engine, alternator, circuit wiring diagrams and factory test sheets will have to be supplied.

Manufacturer's specification for engine and alternator to accompany tender.

Spare Parts

Standard spare parts kit for 2500 hours operation of the set should be included in the tender price.

22.10. CENTRALISED TELEVISION SYSTEM

The television system shall generally be centrally connected and distributed per Block. The television system per Block shall comprise of a DSTV Dish, UHF/VHF Antenna, Amplification and Distribution accessories and a fully integrated wiring system. However, each Apartment shall have two access points connected to the System as per drawings. The Contractor shall provide both accessible wireways to facilitate the installation in accordance with the design and faceplates to outlets.

Wiring from distribution points to television outlets will be carried by the Contactor in 25 mm diameter conduits. Co-axial cables suitable for the television installation shall be used. Television outlet points shall be flush mounted with a steel box.

22.11. TELECOMMUNICATION SYSTEM

11.1 Telephone System

The contractor will liaise with the Telecommunication Service providers to provide telephone lines as specified in the Bills of Quantities.

The system shall be of IP Telephony.

Wiring from distribution points to telephone outlets will be carried by the Contractor in 25mm diameter conduits and or trunking. Cables suitable for data signal shall be used. High quality 8-Core standard fibre optic cable shall be laid in PVC sleeves, connecting different buildings to the server room.

Single Category 6 UTP Telecommunication outlet points shall be used, to accommodate IP Phones.

11.2 Data Installation

Provision for computer terminal outlets will comprise of plastic boxes suitable for trunking mounting complete with data socket outlets and all related trunking/conduit work for carrying the Cat. 6e data cabling. These facilities shall provide a complete cable containment system, from the position of the Patch panel equipment and location. Cabling to the data outlets shall be provided as specified in the Bills of Quantities.

11.3 Cabling and Connecting Accessories

The rates inserted in the Bills of Quantities for the IP telecommunication system shall include all necessary cabling and connecting accessories as to fully complete the installation.

11.4 Uninterruptible Power Supply (UPS)

Uninterruptible Power Supply shall be provided for the Voice & Data System, to be installed in the Server Room. The works shall include supply, Installation, Test and Commission of a 5kVA, 240V Sine Wave Uninterruptible Power Supply Units complete with the following Specifications to MGE Galaxy 3000, Powerware manufacture or Equivalent.

22. 12. FIRE DETECTION

The works shall include upply and installation of the fire detection and alarm system elements complete with fixing accessories of the Menvier / GENT analogue addressable fire detection system or approved equivalent.

The system components shall be Loop wired using using 2-core fire resistant OHLS 300/500V stranded copper cables.

The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.

22. 13. CLOSED CIRCUIT TELEVISION (CCTV) SURVEILLANCE SYSTEM

The works shall involve Supply and installation of a Closed Circuit Television (CCTV) Surveillance System complete with mounting accessories, of the Proline - UK System / BOSCH or approved equivalent.

The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.

22.14. TRAFFIC CONTROL LIGHTS SYSTEM

The works shall involve Supply and installation of a traffic control lights system. The system shall also guide traffic through change of driving lanes at crossing of country borders.

The works shall also include preparation of 3 Sets of Hard and Soft Copies of "As-Built" Drawings, Manuals, Testing and Commissioning the System to the Satisfaction of the Engineer.

22. 15. TESTING AND INSPECTION

15.1 Testing of Earthing System

The resistance of the earth continuity system, when measured between the main earthing point and any other point in the installation, including all conduit and metal work which may provide a path to earth, shall not exceed 0.5ohms where steel conduit forms part or whole of the system, or 1.0 ohms if the earth continuity system is composed entirely of copper, copper alloy or aluminium. The Contractor is expected to allow for any necessary additional materials required to achieve the above resistance values.

15.2 Installation Testing

After completion and before commissioning, the entire installation shall be subjected to the following tests and any faults found shall be rectified by the Contractor at no extra cost.

Polarity

All fuses and control devices shall be connected in live conductors only.

Insulation Resistance

When tested with a 500V DC supply, the insulation resistance between conductors of live lines, lines and neutral, line and earth, neutral and earth shall not be less than 1 mega-ohm.

Earth Continuity Resistance

Resistance of earth continuity measured from a control pillar to the farthest end of a circuit shall not exceed 0.5 ohms.

In addition to the above, the following tests and inspection shall be carried out where applicable:-

i) Phase rotation
ii) Earth loop impedance
iii) Operation of over current and earth fault relays by injection test.
iv) Operation of all other protective relays and devices.
v) Levels of illumination.
vi) Correct sequencing of all control equipment.
vii) Visual inspection

The Engineer shall be given full opportunity to witness all tests and shall approve all test results.

The Engineer shall have the right to ask for specific tests to be repeated.

22. 16. COMMISSIONING AND SYSTEM DEMONSTRATION

The whole installation shall be tested to the statutory requirements of Burundi and Tanzania, IEE Wiring Regulations and commissioned in the presence of and to the satisfaction of the Engineer.

Four copies of test reports shall be provided within seven days of carrying out the test; and the reports shall include full details of how each test was carried out and a copy of all readings taken. These shall include in the Operating and Maintenance Manuals as stated elsewhere in the Specification.

Subsequent to the completion of all testing and commissioning to the approval of the Engineer, prior to the date of issue of the Practical Completion Certificate, the Contractor, when required by the Engineer, shall operate the plant and demonstrate that the overall systems function automatically correctly in accordance with the requirements of this Specification. A period of at least one week's full running and operation including cost of fuel and other input shall be considered reasonable for this demonstration and shall be included in the Contractor's price inserted in the Tender documents. During this period the Contractor shall be responsible for the operation and maintenance, if applicable, of the plant and may if appropriate, use this time to instruct the Employer's staff in the operation and maintenance of the systems. The Contractor will provide an operational report of the demonstration.

23.0 PARTICULAR SPECIFICATIONS FOR MECHANICAL INSTALLATIONS

SPECIFICATION FOR MECHANICAL INSTALLATION MATERIALS AND WORKS

PLUMBING AND DRAINAGE

22.1. GENERAL

This section specifies the general requirements for plant, equipment, and materials forming part of the following:

a) Plumbing and Drainage
b) Cold water Supply and Storage
c) Fire Fighting Installation

22.2 APPROVAL

The Contract works must be carried out strictly in accordance with the following documents:-

i) Local Burundi and Tanzania laws and by-laws and Utility and Local Authority requirements.

ii) Relevant British Standard Specifications and Codes of Practice, published by the British Standards Institution (hereafter referred to as B.S. and C.P. respectively) as implemented in Burundi and Tanzania.

iii) The Performance Specification.

iv) Any working drawings produced by the Contractor and approved by the Engineer.

v) The Engineer's instructions, drawings and details.

The Contractor shall undertake all modifications demanded by the authorities in order to comply with the regulations, and produce all certificates, if any, from the authorities without extra charge.

After the Contract works are handed over to the Client, the contractor will submit as built drawings to be approved by the Engineer after which the contractor will submit to the Client a set of as built drawings in hard and soft copies.

22.3 MATERIALS

a) Copper Tubing

All copper tubing shall be manufactured in accordance with B.S. 659 from C.106 'Phosphorus De-oxide Non-Arsenical Copper' in accordance with B.S 6071.

Pipe joints shall be made with soldered capillary fittings and connection to equipment shall be with compression fittings manufactured in accordance with B.S. 864.

Copper tubing is to be used as connection tubes between steel pipe work and sanitary or laboratory fittings. In order to avoid direct contact a brass straight connector shall be positioned between the steel pipe and the copper tube.

b) Galvanised Steel Pipe work

Galvanised steel pipe work shall be manufactured to comply in all respects with the standards described for black steel pipe work in para. (a) above.

Galvanising shall be carried out in accordance with the requirements of B.S. 1387 and 143 respectively.

c) PPR pipes and fittings

The PPR pipes and fittings shall be produced from polypropylene Random type PN25 material or equivalent which has high molecular weight and excellent creep resistance.

The installation shall be in accordance with the manufacturers' recommendation with provision for expansion, including all necessary fittings and accessories. The pipe shall be tested at 15 bars for one hour, immediately after the preliminary test, the main test shall be carried out at 10bars for 24 Hours. There shall be no leakage of any kind not even in the form of moisture in either of the tests. The installation must be perfectly tight.

d) PVC pressure pipe work

All P.V.C pipes for cold water services shall comply with the requirements of BS 3505 and all fittings shall comply with BS4346.

e) uPVC. 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.

f) Stop-Cocks , Taps and Stop Valves

Stop cocks for underground use shall be plug cock pattern or screw down pattern complying with requirements of B.S.2580.

Taps and stop valves shall be screw down pattern and shall comply with the requirements pf B.S. 1010 fitted with washers complying with B.S.3457. Hose taps and

hose connections shall have outlet nosels screwed in accordance with the requirements of B.S.1010.

g) Gate Valves

All gate valves 50mm nominal bore and above, other than those required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of B.S. 5150. All gate valves required for fitting to burried water mains shall be of cast iron construction in accordance with the requirements of B.S. 5163.

All gate valves up to and including 50mm nominal bore shall be of bronze construction in accordance with the requirements of B.S. 1952.

The pressure classification of all gate valves shall depend upon the pressure conditions pertaining to the site of works.

h) Globe Valves

All globe valves up to and including 50mm nominal bore shall be of bronze construction in accordance with the requirements of B.S. 5154. The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the site of works.

i) Gas Valves

To be globe valves in accordance with B.S. 5154.

j) Check or Non-return Valves

All check or non-return valves up to and including 50mm nominal bore shall be of the swing check type of bronze construction in accordance with B.S. 5154.

All check or non-return valves 50mm nominal bore and above shall be of the swing check type of cast iron construction in accordance with the requirements of B.S. 5153.

The pressure classification of all check non-return valves shall depend on the pressure conditions pertaining to site of the works.

k) Ball Valves

All ball valves for use in connection with hot and cold water services shall be of portmouth type in accordance with the requirements of B.S 1212 and construction of bronze or other non-corrosive material.

l) Waste Fitment Traps

i) Standard and Deep Seal P & S Traps

Where standard or deep seal traps are specified they shall be manufactured in suitable non-ferrous materials in accordance with the full requirements of B.S. 1184.

ii) Anti-Syphon Traps

Where anti-syphon traps are specified, these shall be similar or equal to the range of traps manufactured by Greenwood and Hughes Ltd., Deacon Works, Littlehampton, Sussex, England.

The trade name for traps manufactured by this Company is 'Grevak'.

22. 4. WORKMANSHIP

a) Water Services Installation

All work shall be carried out in accordance with C.P.342 and C.P.310 and to the approval of the Engineers

All water systems shall be provided with sufficient drain points and automatic air vents to enable them to function correctly. Valves and other user equipment shall be installed with adequate access for operation and maintenance. Where valves and other operational equipment are unavoidably installed beyond normal reach from a short step ladder, extension spindles with floor or wall pedestals shall be provided.

Screwed piping shall be installed with sufficient number of unions to facilitate easy removal of valves and fittings, and to enable alterations of pipework to be carried out without the need to cut the pipe.

Full allowance shall be made for the expansion and contraction of the pipework, precautions being taken to ensure that any forces produced by pipe movements are not transmitted to valves, equipment or plant. All screwed joints to piping and fittings shall be made with P.T.F.E. tape.

b) Sanitary Services

Soil, waste and vent pipe systems shall be installed in accordance with the best standard of modern practice as described in B.S. 5572:1978 to the approval of the Engineer.

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It shall be ensured that all ground floor waste fittings are discharged to a gulley trap before passing to the sewer via a manhole.

All necessary roding and inspection facilities shall be provided within the draining system in positions where easy accessibility is available.

Where a branch requires roding facilities in a position to which normal access is unobtainable, then that branch shall be extended so as to provide a suitable purpose made roding eye in the nearest adjacent wall or floor to which easy access is available.

The vent stacks shall terminate above roof level and where a stack passes through the roof, a weather skirt shall be provided. The roof shall be sealed after installation of the stacks.

The open of each stack shall be fitted with a plastic coated, or galvanised steel, wire guard.

Access for roding and testing shall be provided at the foot of each stack.
All sanitary appliances associated with the works shall be installed in accordance with CP 305 to the approval of the Engineer.

c) Pipe Supports for Suspended Pipework

Pipe runs shall be secured by pipe clips connected to pipe hangers, wall brackets, or trapeze type supports. 'U' bolts shall not be used as a substitute for pipe clips without the prior approval of the Engineer.

The support spacing for vertical runs shall not exceed one and a half times the distances given for horizontal runs.

An approximate guide to the maximum permissible supports spacings in metres for steel and copper pipe and tube is given in the following table for horizontal runs:

Size Nominal Bores	**Copper Tube to B.S. 659**	**Steel Tube to B.S. 1387**
15mm	1.25m	2.0m
20mm	2.0m	2.5m
25mm	2.0m	2.5m
32mm	2.5m	3.0m
40mm	2.5m	3.0m
50mm	2.5m	3.0m
65mm	3.0m	3.5m
80mm	3.0m	3.5m
100mm	3.0m	4.0m
125mm	3.5m	4.5m
150mm	4.5m	5.5m

d) Underground pipe lines

All underground water and drainage service installations shall be according to modern practice as described in C.P. 301 and C.P. 310 respectively.

The following sequence shall be followed for operation for Underground Service Installation:

i) Setting Out

As described in B.S. Code of Practice 301 Clause 502

ii) Breaking up Surface (if in roads)

As described in B.S. Code of Practice 301 Clause 503

iii) Excavation for Water Main

As described in B.S. Code of Practice 301 Clause 503 and the following:-

The contractor shall excavate the pipe trenches in the line and to the depths indicated on the drawings or directed by the Engineer, all pipes must have a minimum cover of 50mm over top of the barrel of the B49 pipe when laid, plus or minus a tolerance of 75mm either way. All trenches shall be excavated in open cuttings.

Where the trench passes through grassland, arable land or garden, whether enclosed or otherwise, the turf, if any, shall be pared off and stacked, and the productive soil shall be carefully removed for a width of 600mm greater than the normal trench width, or equal to the overall width of track of the excavating machine whichever is greater, and laid aside to be subsequently used in reinstating the surface of the ground after the trench has been refilled.

The bottom of the trench shall be properly trimmed off, and all low places or irregularities shall be levelled up with fine material. Where rock or large stones are encountered, they shall be cut down to a depth of at least 75mm below the level at which the bottoms of the barrel of the pipes are to be laid, and covered to a like depth with fine material, so as to form a fine and even bed for the pipes.

Joint holes shall be excavated to such minimum dimensions as will allow the joints to be well and properly jointed.

The pipe trench shall be kept clear of water at all times.

The Contractor shall, whenever necessary, by means of timbering or otherwise, support the sides of the trench so as to make them thoroughly secure, and afford adequate support to adjoining roads, lands, building and property, during the whole time the trench remains open and shall remove such timbering when the trench has been backfilled. The cost of such timbering or other work shall be deemed to be included in the rates for excavation. In case the Contractor is instructed by the Engineer to leave any portion of such timber in position, the contractor will pay for it accordingly.

The clear width inside the timbering, in the case of single pipes, shall be at least 320mm in excess of the external diameter of the pipe being laid, in order to allow it to be freely lowered into position in the trench without damage to the external protection.

There more than one pipe is to be laid parallel, then the clear width inside the timbering shall be at least 520mm in excess of the combined external diameters of the pipes.

Any excavation below the specified depth, in error or without the instruction of the Engineer as the case may be, shall be refilled to the correct levels, at no extra cost, with mix 1:3:6 concrete or other approved material.

If a mechanical excavator is used by the Contractor, he shall indemnify the Employer against all claims for damage which, in the opinion of the Engineer, may have been caused by the use of this point. When a mechanical excavator is used the bottom 230mm of excavation shall be excavated by hand to ensure an even bed for the pipes.

iv) Excavation for Drainage pipes

Excavation shall be made to such depths and dimensions as may be required by the Engineer to obtain proper falls and firm foundations. No permanent construction shall be commenced on any bottom until the excavation has been examined and approved by the Engineer.

Prices shall include for excavating in all materials met with, for trimming bottoms to the necessary falls and for excavation required for planking and strutting and working space.

All prices shall include for keeping the whole of the trenches or other excavations free from water and for execution of such works and install such pumps as may be necessary to keep the excavations dry at all times. No sub-soil water shall be discharged into the sewage systems without written permission of the Engineer.

vi) Laying of Concrete Beds or other Supports for Pipes (if required)

As described in B.S. Code of Practice 301 Clause 504 and the following:

All drains below buildings shall be encased in concrete 150mm thick. Drains below roads shall be protected by a reinforced concrete slab, 300mm below surface. 150mm thick and with same width as the trench.

Concrete beds and supports shall be concrete of mix 1:3:6 to 25mm maximum aggregate size.

vi) Pipe Laying and Jointing

Drain pipes shall be laid and jointed as described under B.S. Code of Practice 301 Clause 505.

Water pipes shall be laid and jointed as described under B.S. Code of Practice 310, Clause 401, 402, 403, and 404.

vii) Protection of Underground Steel Pipes

Where laid underground, mild steel piping shall be protected by 'Denso' tape, or similar, wound on at least two layers thick or given two coats of approved bitumen.

viii) Manholes and Inspection Chambers

Manholes and inspection chambers shall be constructed in accordance with the drawings and in the position shown on the drawings or directed by the Engineer. Foundation slabs and benching shall consist of concrete of the appropriate grades.

Benching to manhole floors shall have a minimum fall of 1 in 12 from the manhole walls and shall be finished tangentially vertical to the bore of the channel diameter. The intersection of the channel sides and the benching shall be finished in a sharp curve not greater than 30mm in diameter.

The benching shall be formed of concrete, as specified, floated to a hard smooth surface with a coat of cement mortar (1:1).

If required half channel pipes, bends and junctions shall be laid and bedded in cement mortar (1:3) to the required lines and levels, and both sides of the channel pipes shall be benched up with concrete of the appropriate grade and finished smooth to the slopes and levels as shown on the drawings or directed by the Engineer. The ends of all pipes shall be neatly built in and finished flush with cement mortar (1:3).

Walls of manholes and access shafts shall be constructed of concrete block work as specified in accordance with the drawings.

Walls shall be rendered internally for the full height with a cement and mortar (1:3) of at least 12mm thickness finished with a completely smooth surface.

Cast iron manhole covers and frames as specified shall be provided and the frames shall be bedded in cement mortar (1:3) and so set that the tops of the covers shall be flush at all points with the surrounding surface of the footway, verge or carriageway, as the case may be. Any slight adjustment of the cover level which may be necessary to accomplish this shall be effected by topping the sidewalls with concrete integral with the slab.

Where the depth of the invert exceeds 1 metre below the finished surface of the carriageway or the adjacent ground, step irons of heavy galvanised cast iron or galvanised mild steel round bar shall be built in 300mm apart with alternate steps in line vertically and with such additional hand irons as the may direct. Step irons must be set into the walls when these are built and not subsequently.

All manholes when completed shall be watertight and to the satisfaction of the Engineer.

Vertical backdrops shall be positioned inside the manholes or tanks and be constructed in cast iron or PVC drain pipes and fittings.

ix) Gulley Connections

Connection from gullies to sewers and surface water drains or ditches shall consist of PVC pipes and fittings as specified jointed with push-fit joints. All pipes, bends and junctions shall be laid to the lines and levels shown in the drawings or as directed by the Engineer.

x) Surface Boxes, covers, etc.

Surface boxes, manhole and other covers lying within the site of the works, shall be raised, lowered, altered or removed as directed by the Engineer.

xi) Testing of Pipelines

After pipelines are connected up and joints have been sealed, the pipeline shall be tested before pipes are , if required, haunched or surrounded in concrete.
Methods of testing and inspection shall be in accordance with the requirements of the appropriate section in this Specification.

xii) Concrete bedding, Haunching and Surround

Concrete bedding, haunching and surround shall be provided as necessary or where called for by the Engineer in accordance with the requirements laid down in B.S. Code of Practice 301, Clause 310.

xii) Backfilling

Backfilling of trenches, headings and around manholes shall be carried out in accordance with the methods described in B.S. Code of Practice 301, Clause 508.

xiii) Reinstatement of Surfaces

Following the final backfilling of all trenches, headings and manhole surrounds, the surface of the excavated areas shall be fully reinstated to the approval of the Engineer.

Where excavations have been carried out in public highways or other areas not forming part of the site, prices will be deemed to allow for all charges associated with the temporary and final reinstatement requirements of the Local Highway Authority.

c) Sanitary Appliances

All sanitary appliances associated with the works shall be installed in accordance with CP 305 to the approval of the Engineer.

5.0 COLD WATER BOOSTER PUMPS

Cold water pumps shall boost water between the Main reservoir Tank and sanitary draw off points. The pump shall start and stop automatically by pressure contactor to meet the demand. The cold water pump booster set shall comprise the following:- One Electric motor driven pump, one jockey pump, pressure vessels, valves and accessories complete with a control panel.

6.0 TESTING AND INSPECTION

The following site tests for the pipework systems shall be carried out as part of the installation and shall be deemed to have been allowed for in the price.

a) Underground Water Mains

After laying, jointing and anchoring, the main shall be slowly and carefully charged with water, so that all air is expelled and allowed to stand full for three days before testing under pressure.

Tests shall be applied to sections of pipelines not exceeding 1000 metres in length or such lesser lengths as may be required, and pipe joints shall be left uncovered.

The open end of the main may be temporarily closed for testing under moderate pressure by fitting a water pipe expanding plug, of which several types are available. The end of the main and the plug should be secured by struts or otherwise, to resist the end of thrust of the water pressure in the main. If the section of the main tested terminates with a sluice valve, the wedge of the valve shall not be used to retain the

water, with a plug and the wedge shall be placed in the open position while testing. Suitable end supports shall be provided to withstand the end thrust of the water pressure in the main.

The test pressure shall be applied by means of a manually operated test pump or, in case of a long mains of large diameter, by a power driven test pump that shall be taken to ensure that required pressure is not exceeded. Pressure gauges should be recalibrated before the tests.

Prices shall be deemed to include for all test pumps and other equipment required under this clause of the specification.

The test pressure shall be one and half times the maximum working pressure except where a pipe is manufactured from a material for which the relevant BS specification designates differently, otherwise the maximum test pressure should not exceed 120, 180 and 240 metre head for class B,C or D pipes respectively.

The pipeline or pipework shall be filled with water in such a manner as to prevent any shock or water hammer and allow for the complete evacuation of air, and kept under observation for leakages at static head for twenty four hours. If there are no leakages the pressure shall be raised slowly to the required test pressure for that pipeline and maintained at that pressure for a period long enough for the Engineer to examine the whole section under test, or not less than 4 hours which ever is the longer period. Thereafter, for a period of 2 hours the leakage of water , as measured by the amount drawn into the pump to maintain the pressure must not exceed a rate of 0.1 litre per millimetre nominal internal diameter per kilometre length of main per 30 metres head for each 24 hours.

All pipes or joints which are proved to be in any way defective shall be cut out, remade and retested as often as may be necessary until a satisfactory test is obtained and any work which fails or is proved by test to be unsatisfactory in any way shall be cut out and redone by the contractor at his own expense.

In addition to the tests in separate sections, on completion the main shall be tested in whole or in parts to the same pressure and by the same procedure as that outlined for individual sections.

During pipe laying the gauge shall remain in the pipeline and shall be pulled by a stout rope or chain which shall be threaded through each successive pipe or tube so that the gauge is never more than one pipe length behind laying. Any debris collected in front of the gauge shall be regularly cleaned out before the next pipe is placed in position.

b) Above ground internal water service installation

All water service pipe systems installed above ground shall be tested hydraulically for a period of one hour to not less than one and a half times the design working pressure.

If preferred, the pipe line may be tested in sections. Any such section found to be satisfactory need not be the subject of a further test when the system has been completed, unless specifically requested by the Engineer.

During the test, each branch and joint shall be examined carefully for leaks any defects revealed shall be made good and the section re-tested.
All necessary precautions shall be taken to prevent damage occurring to special valves and fittings during the tests.

Any item damaged shall be replaced or repaired.

c) Underground Drainage System

A site test shall be carried out on all drainage pipes before concrete haunchings or surrounds are applied. These tests shall be carried out preferably from manhole to manhole.

Short branch drains connected to a main drain between manholes shall be tested as one system with the main drain. In long branches a testing junction shall be inserted next to the junction with the main drain and the branch tested separately. After the test has been passed, the testing junction shall be effectively sealed.

All tests on underground drains shall be water tests. Smoke test shall not be permitted.

In certain circumstances , air tests may be permitted on cast iron drains at the discretion and to the approval of the Engineer.

Water tests shall be carried out in accordance with the methods described under B.S. Code of Practice 301, Clause 601 (b) and (c) and the test pressure shall not be less than 1.52m head at the highest point in the pipe section and not more than 10.36 m head at any point in the section.

The test pressure shall be maintained for a period of one hour during which time the pipes and joints shall be inspected for sweating and leakage. Any leaks discovered during the test shall be made good and the section re-tested.

In addition to pressure tests, drain pipe runs shall also be tested for straightness where applicable. The test shall be carried out in accordance with one of the two methods described in B.S. Code of Practice 8301, Clause 602.

d) Above Ground Soil, Waste and Ventilating Pipe System

All soil, waste and ventilating pipe system forming part of the above ground installation, shall be given a smoke test to a pressure of 39mm of water gauge and this pressure shall remain constant for a period of not less than 3 minutes.
Water tests on above ground soil, waste and ventilating pipe systems shall not be permitted.
Pressure tests shall be carried out before any work which is to be concealed is finally enclosed.

Any defects revealed by the tests shall be made good and the test repeated to the approval of the Engineer. In all other respects , tests shall comply with the BS58 requirements of B.S. Code of Practice 5572.

Following satisfactory pressure tests on the pipe work systems, operational tests shall be carried out in accordance with the relevant B.S. Code of Practice on the system as a whole to establish that special valves, gauges, controls, fittings, equipment and plant are functioning correctly to the satisfaction of the Engineer.

7.0 COLOUR CODING IN GENERAL

All pipe work shall be colour coded in accordance with the latest edition of B.S. 1710.

8.0. STERILIZATION OF HOT AND COLD WATER SUPPLY SYSTEM

The sterilisation procedure shall be carried out in accordance with the requirements of the BS Code of Practice 310, Clause 409 to the approval of the Engineer. The pipelines after testing shall be throughly flushed out and cleaned.
After the Engineer has approved the cleaning, the Contractor shall completely fill the pipelines with water to which he shall have added chloride of lime or other approved chemical to give a concentration of free chlorine of 50mg per litre.

Chlorine gas must not be injected direct into the main from a cylinder otherwise than through an approved chlorinator and care must be taken to ensure that there is no flow back into the preceding sections of the main.

The method used for sterilisation shall be approved by the engineer and solution allowed to remain in the pipelines for not less than 6 hours, nor more than 24 hours. Chlorine residual test shall then be taken at the end of the main furthest from the dosing point. The sterilisation process shall be repeated until the free chlorine residual is less than 5mg per litre. The chlorine residual tests shall be carried out on site in order to obtain an accurate reading of free chlorine present.

9.0 CHAMBERS AND MANHOLES

Chambers and manholes shall be constructed to the dimensions and general arrangement detailed on the drawings and in the Contract. Chamber covers shall be constructed as for manholes.

10.0 Testing of Manholes

Manholes and other chambers shall be tested by filling with water after completion of backfilling.

The first 1.0 metre of depth may be filled as quickly as supply permits. Between this end and top water level the rate of filling must not exceed 1.0 metre in 24 hours. After filling to top water level , no further water shall be introduced for 2 days. At the end of this period the tanks shall be topped up to water level and allowed to stand satisfactory if the fall in water in 24 hours does not exceed 15mm.

In the event of a fall exceeding the above tank will be emptied and any defects made good prior to re-test as before, all at the Contractors expense.

11. COLD WATER STORAGE TANKS

There shall be 1No. Pressed steel tank of 144,000Litres located on a 15m steel tower stand to act as the main reservoir, complete with provisions for overflow, mains supply connection float valve.

12. FIRE FIGHTING INSTALLATION

a) Pipes and Pipe Fittings

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

Pipe fitting shall be of Wrought steel seamless pipe fitting to BS 1740 part 1: 1971.

Flanges shall be Steel flanges to B.S. 4504: 1969 PN 16

b) Hosereel Installation

i) Pipes and Pipe Fittings

Pipes shall be galvanised steel tubing to BS 1387:1967 Class C with pipe threads to BS 21.
Pipe Fittings shall be Wrought steel seamless pipe fitting to BS 1740 Part 1: 1971.

ii) Valves

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

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

iii) Hosereels

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

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

iv) Pumps

Fire Hosereel pumps shall consist of a duplicate set of end-suction centrifugal pumps, each pump rated for 2.27 litres per second flow producing a minimum head to all

hosereels of 25 metres and one number diesel engine driven centrifugal pump, pressure vessel, valves and accessories.

Each pump shall be supplied complete with an electric motor, baseplate, antivibration mountings, gate valve on suction port and ate plus non-return valve on the discharge port.
The common suction pipe to the duplicate pumps set shall be fitted with an in-line strainer to BS 5154, generally as Crane type D 287 and foot valve strainer.

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

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

v) Fire Extinguishers

Water/Carbon Dioxide Extinguishers shall be 9 litre/6kilogrammes nominal capacity water filled carbon dioxide cartridge operated portable fire extinguishers to comply with BS 1382.

Dry Powder Extinguishers shall be 9 kg nominal capacity non-toxic, water-repellant power charged/compressed gas expellant portable fire extinguisher to comply with BS 3465 supplied complete with discharge/directional hose.

24.0 AIR CONDITIONING & MECHANICAL VENTILATION

24.0 General

The particular and general specifications for the Airconditioning and Mechanical ventilation are detailed in this part. The Contractor shall supply and install Airconditioning and Mechanical Ventilation equipment as detailed herein and in the Contract Drawings.

24.2 Climatic Conditions

The following climatic conditions apply at the site of the Contract Works and all plant, equipment, apparatus, materials and installations shall be suitable for these conditions.

Max. Highest Temp.	35 degrees Celsius
Min. Lowest Temp.	13.3 degrees Celsius
Mean Temp.	28 degrees Celsius
Relative Humidity	50% - 92%
Altitude	1312 meter A.S.L.
Longitude	32 degrees 36' E
Latitude	00 degrees 20' N

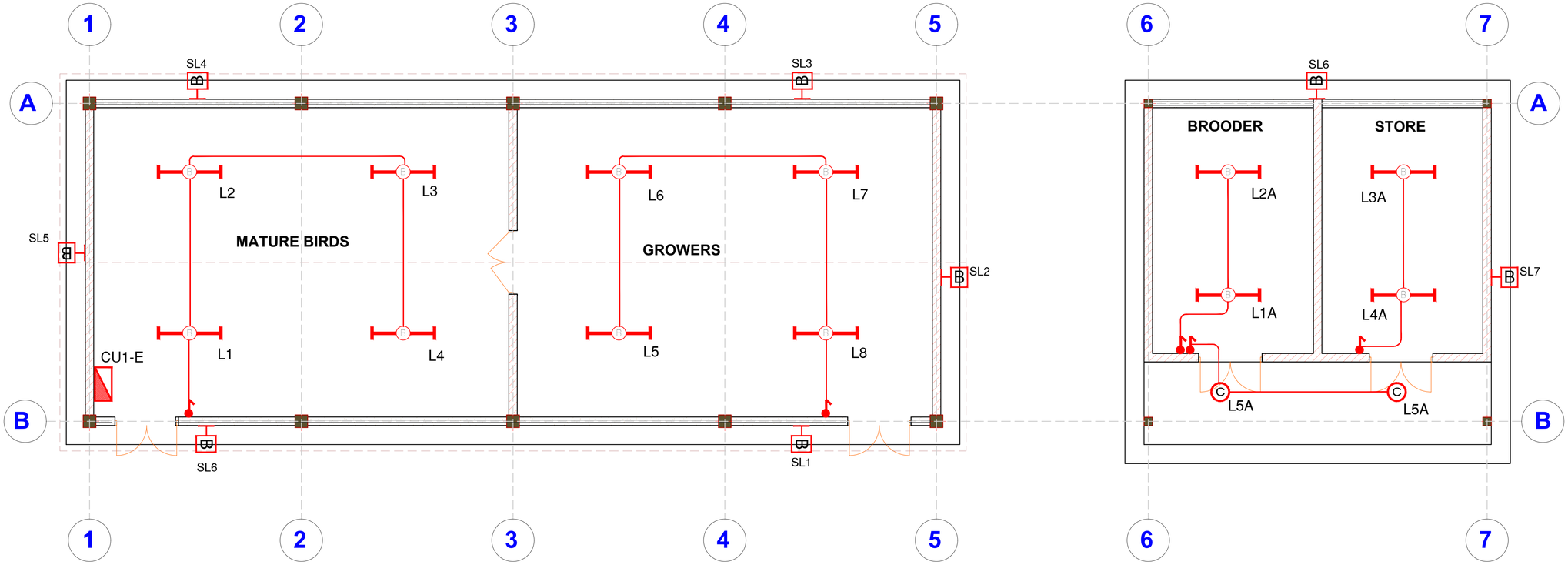
24.3 Design conditions for air conditioning installation

a) Inside temperature for all areas shall be 22 degrees Celsius. All Noise Level Max 45dB

b) Outside conditions: Temperature = 35 degrees Celsius, dry bulb;

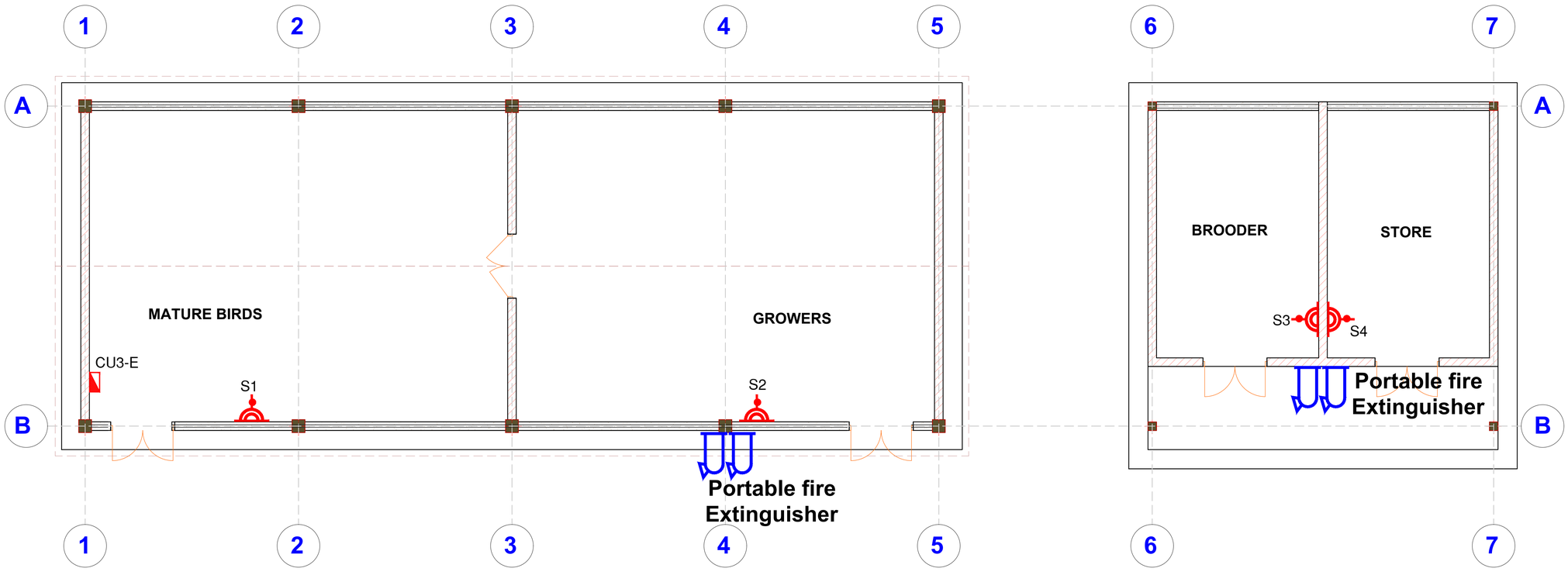
AIR CONDITIONING SYSTEM

The air conditioning system shall be Split Unit systems as Ceiling cassettes and High wall mounted units. The proposed products shall be either Toshiba/ Daikin/Carrier/LG. These will mainly be located in the sever rooms and IT rooms.



GROUND FLOOR PLAN

POULTRY HOUSE , LIGHTING INSTALLATION LAYOUT.



GROUND FLOOR PLAN

POULTRY HOUSE , SMALL POWER INSTALLATION LAYOUT.

NOTES

1. THIS DRAWING HAS A COPYRIGHT AND THE WORK EXECUTED FROM IT , IS THE PROPERTY OF THE CONSULTANT
2. ALL DIMENSIONS MUST BE CHECKED ON SITE BY THE CONTRACTOR BEFORE WORK COMMENCES
3. FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALING OFF DRAWING
4. ANY DISCREPANCIES TO BE REPORTED TO THE OFFICE OF THE CONSULTANT
5. ALL RC COLUMNS, SLABS, FOUNDATIONS AND ROOF STRUCTURE TO STRUCTURAL ENGINEER'S DETAILS
6. THIS DRAWING MUST BE READ IN CONJUCTION WITH DRAWINGS CODED THEREIN.
7. PV DENOTES PERMANENT AIR VENTS OVER DOORS AND WINDOWS AS SHOWN ON THE DRAWING
8. WALLS BELOW 200MM THICK ARE TO BE REINFORCED WITH HOOPIRON AT EVERY ALTERNATE COURSE
9. DEPTH OF FOUNDATION TO BE DITERMINED ON SITE
10. DRAINAGE PIPES PASSING UNDER TARMAC, DRIVEWAYS AND BUILDINGS TO BE ENCASED IN 150MM CONCRETE SURROUND
11. ALL REINFORCED CONCRETE WORKS TO BE TO STRUCTURAL ENGINEER'S DETAILS
12. ALL SANITORY WORKS TO BE TO SATISFACTION OF MoH
13. ALL ROADS TO BE TO CIVIL ENGINEER'S DETAILS
14. FOR SOIL AND WATER DRAINAGE REFER TO MECHANICAL ENGINEERS DRAWINGS

PROJECT NAME

CONSULTANCY SERVICES *for* DETAILED ARCHITECTURAL AND ENGINEERING DESIGNS & TECHNICAL SUPERVISION *of* BORDER POST BETWEEN ETHIOPIA *and* SUDAN, BUSINESS INCUBATION CENTRES IN MORUNGOLE, KAABONG DISTRICT, (UGANDA) AND NARUS, KAPOETA EAST COUNTY, (SOUTH SUDAN), A POULTRY-HOUSE FOR AKANDEYU, ETHIOPIA *and* AN ACCESS ROAD FROM MORUNGULE TO NATINGA

Client:

CENTRE FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT.

Project Particulars:

PROPOSED POULTRY HOUSE

Location:

EKENDAYO

Country:

REPUBLIC OF ETHIOPIA.

Consultant

MATOVU JOHN .R

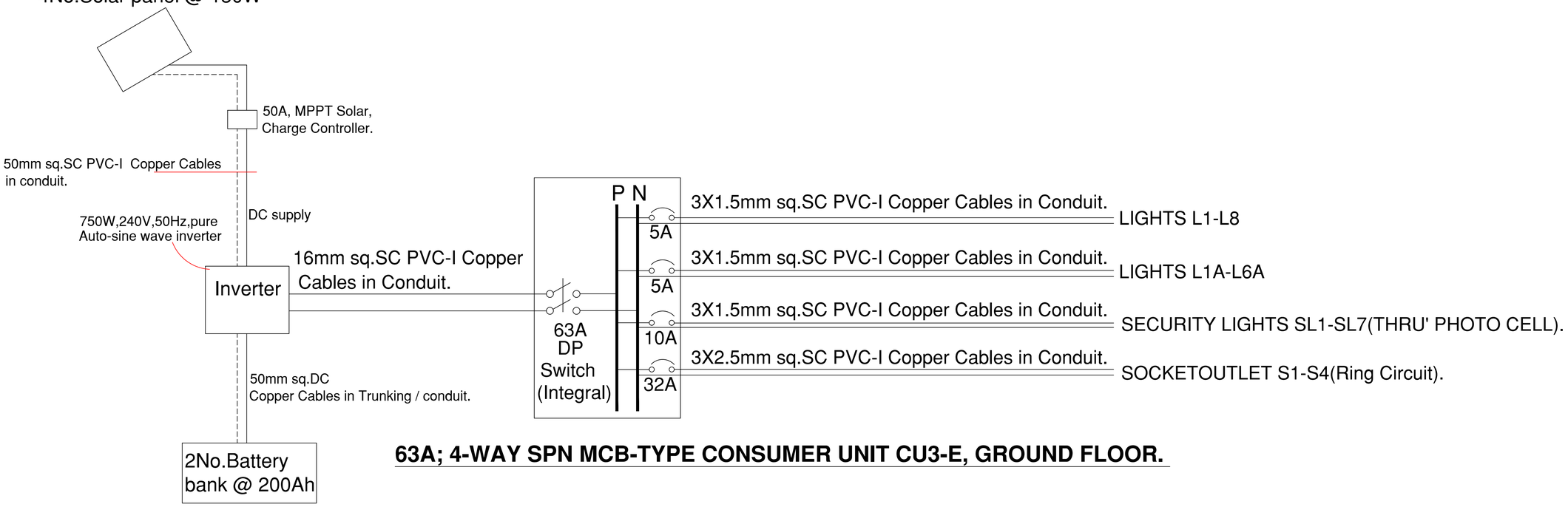
P.O.BOX 3694 KAMPALA

ARB.REG.No.257.

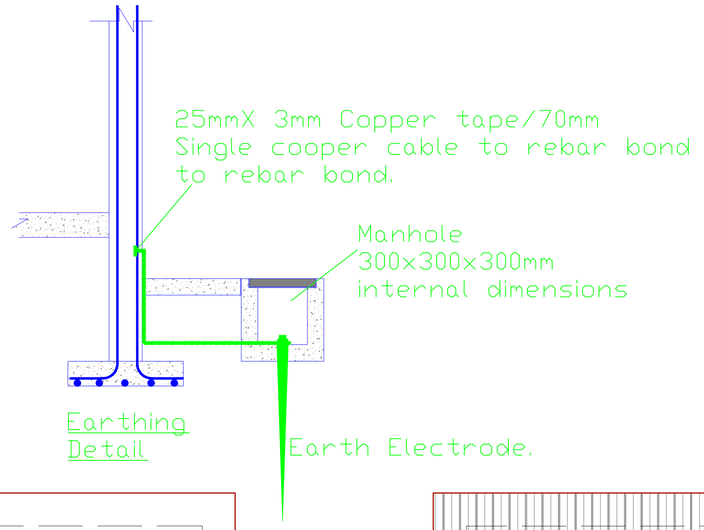
Drg. Title:

ELECTRICAL INSTALLATION LAYOUT.

Sheet no.: **EL/01**	Scale: **As Indicated**
Drawing no.:	Drawn by: **N.M.Z**
Units: **mm**	Checked by: **M.J.R**
Date: **DECEMBER 2024**	



63A; 4-WAY SPN MCB-TYPE CONSUMER UNIT CU3-E, GROUND FLOOR.



LEGEND

AT AIR TERMINAL

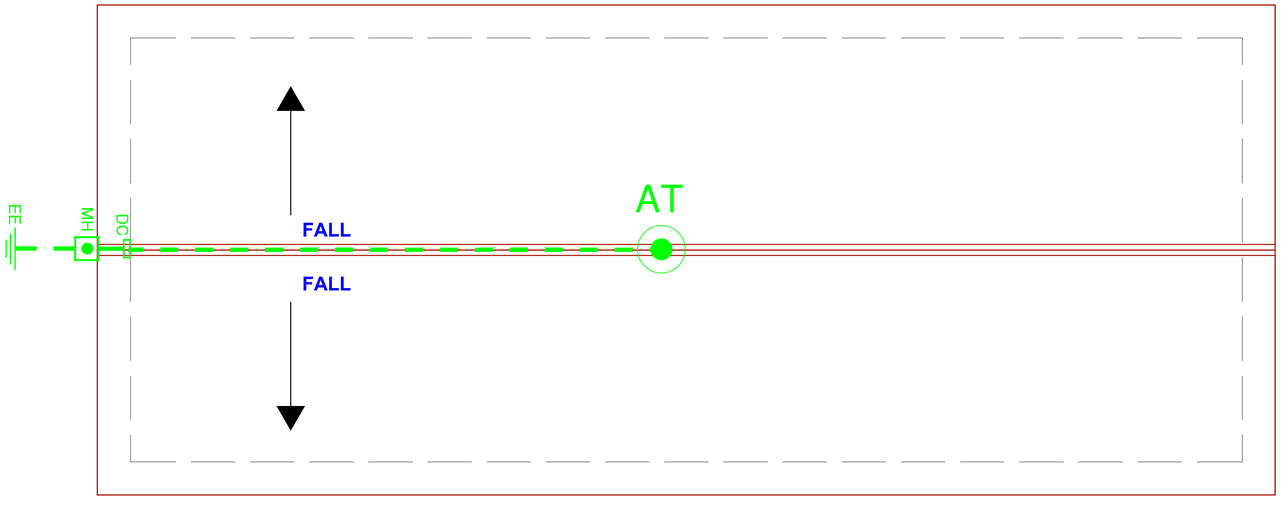
TB TEST BLOCK

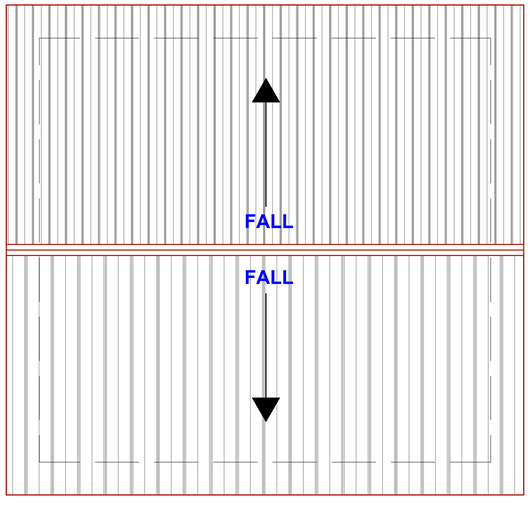
MH INSPECTION MANHOLE

EE EARTH ELECTRODE

HC HORIZONTAL CONDUCTOR COPPER TAPE 3x25mm

DC DOWN CONDUCTOR COPPER TAPE 3x25mm/50MMSQ COPPER CABLE.





ROOF FLOOR PLAN

POULTRY HOUSE , LIGHTNING PROTECTION INSTALLATION LAYOUT.

NOTES

1. THIS DRAWING HAS A COPYRIGHT AND THE WORK EXECUTED FROM IT , IS THE PROPERTY OF THE CONSULTANT
2. ALL DIMENSIONS MUST BE CHECKED ON SITE BY THE CONTRACTOR BEFORE WORK COMMENCES
3. FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALING OFF DRAWING
4. ANY DISCREPANCIES TO BE REPORTED TO THE OFFICE OF THE CONSULTANT
5. ALL RC COLUMNS, SLABS, FOUNDATIONS AND ROOF STRUCTURE TO STRUCTURAL ENGINEER'S DETAILS
6. THIS DRAWING MUST BE READ IN CONJUCTION WITH DRAWINGS CODED THEREIN.
7. PV DENOTES PERMANENT AIR VENTS OVER DOORS AND WINDOWS AS SHOWN ON THE DRAWING
8. WALLS BELOW 200MM THICK ARE TO BE REINFORCED WITH HOOPIRON AT EVERY ALTERNATE COURSE
9. DEPTH OF FOUNDATION TO BE DITERMINED ON SITE
10. DRAINAGE PIPES PASSING UNDER TARMAC, DRIVEWAYS AND BUILDINGS TO BE ENCASED IN 150MM CONCRETE SURROUND
11. ALL REINFORCED CONCRETE WORKS TO BE TO STRUCTURAL ENGINEER'S DETAILS
12. ALL SANITORY WORKS TO BE TO SATISFACTION OF MoH
13. ALL ROADS TO BE TO CIVIL ENGINEER'S DETAILS
14. FOR SOIL AND WATER DRAINAGE REFER TO MECHANICAL ENGINEERS DRAWINGS

PROJECT NAME

CONSULTANCY SERVICES *for* DETAILED ARCHITECTURAL AND ENGINEERING DESIGNS & TECHNICAL SUPERVISION *of* BORDER POST BETWEEN ETHIOPIA *and* SUDAN, BUSINESS INCUBATION CENTRES IN MORUNGOLE, KAABONG DISTRICT, (UGANDA) AND NARUS, KAPOETA EAST COUNTY, (SOUTH SUDAN), A POULTRY-HOUSE FOR AKANDEYU, ETHIOPIA *and* AN ACCESS ROAD FROM MORUNGULE TO NATINGA

Client:

CENTRE FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT.

Project Particulars:

PROPOSED POULTRY HOUSE

Location:

EKENDAYO

Country:

REPUBLIC OF ETHIOPIA.

Consultant

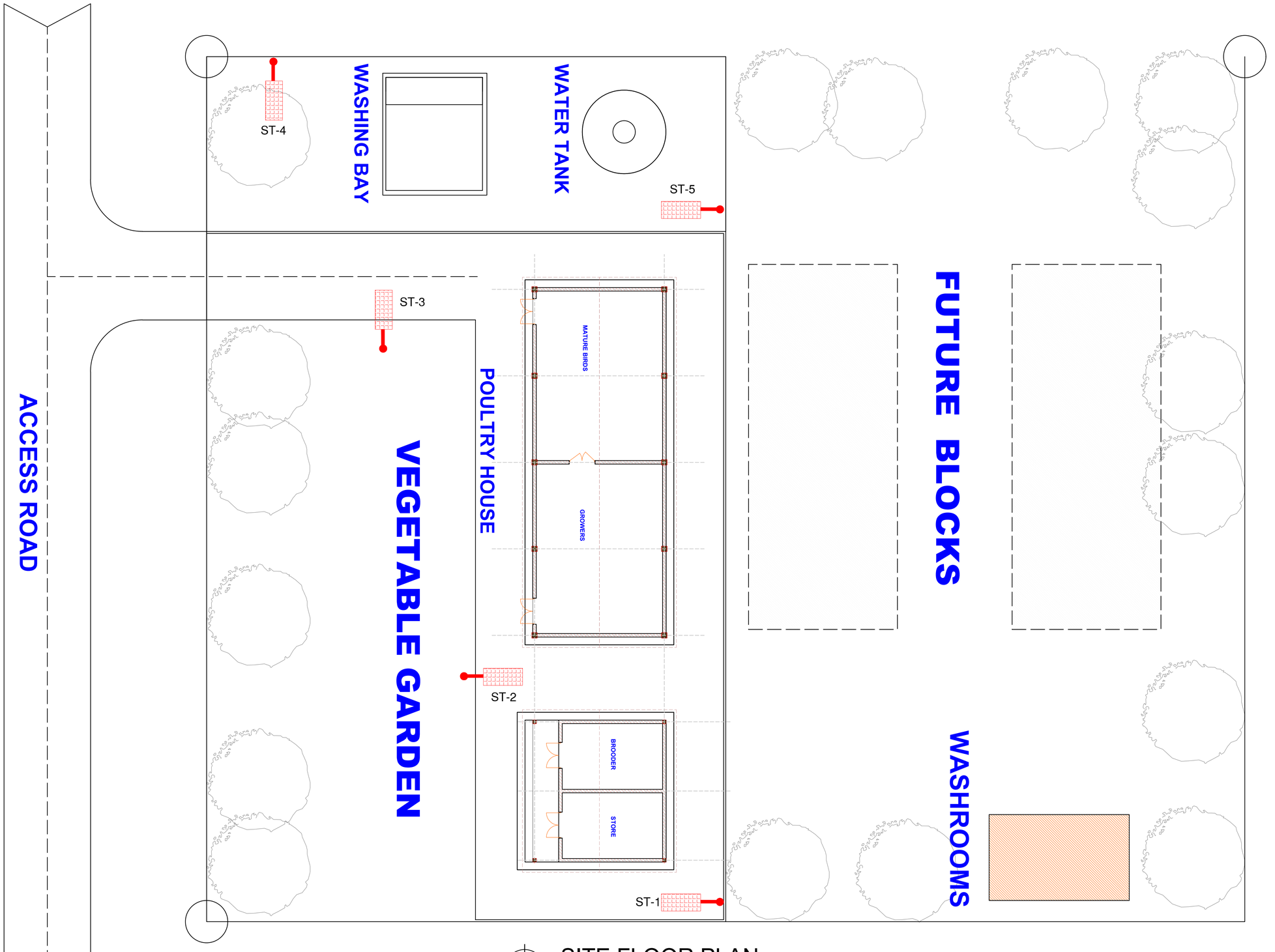
MATOVU JOHN .R
P.O.BOX 3694 KAMPALA
ARB.REG.No.257.

Drg. Title:

ELECTRICAL INSTALLATION LAYOUT.

Sheet no.: **EL/02**	Scale: **As Indicated**
Drawing no.:	Drawn by: **N.M.Z**
Units: **mm**	Checked by: **M.J.R**
Date: **DECEMBER 2024**	

SYMBOLS	DESCRIPTIONS
	ONE GANG, ONE WAY WALL SWITCH
	ONE GANG, TWO WAY WALL SWITCH
	TWO GANG, TWO WAY WALL SWITCH
	4M FREE STANDING SOLAR SECURITY LIGHT FIXTURE.



SITE FLOOR PLAN

POULTRY HOUSE , SOLAR SECURITY LIGHT INSTALLATION LAYOUT.

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EKENDAYO

Country:

REPUBLIC OF ETHIOPIA.

Consultant

MATOVU JOHN .R

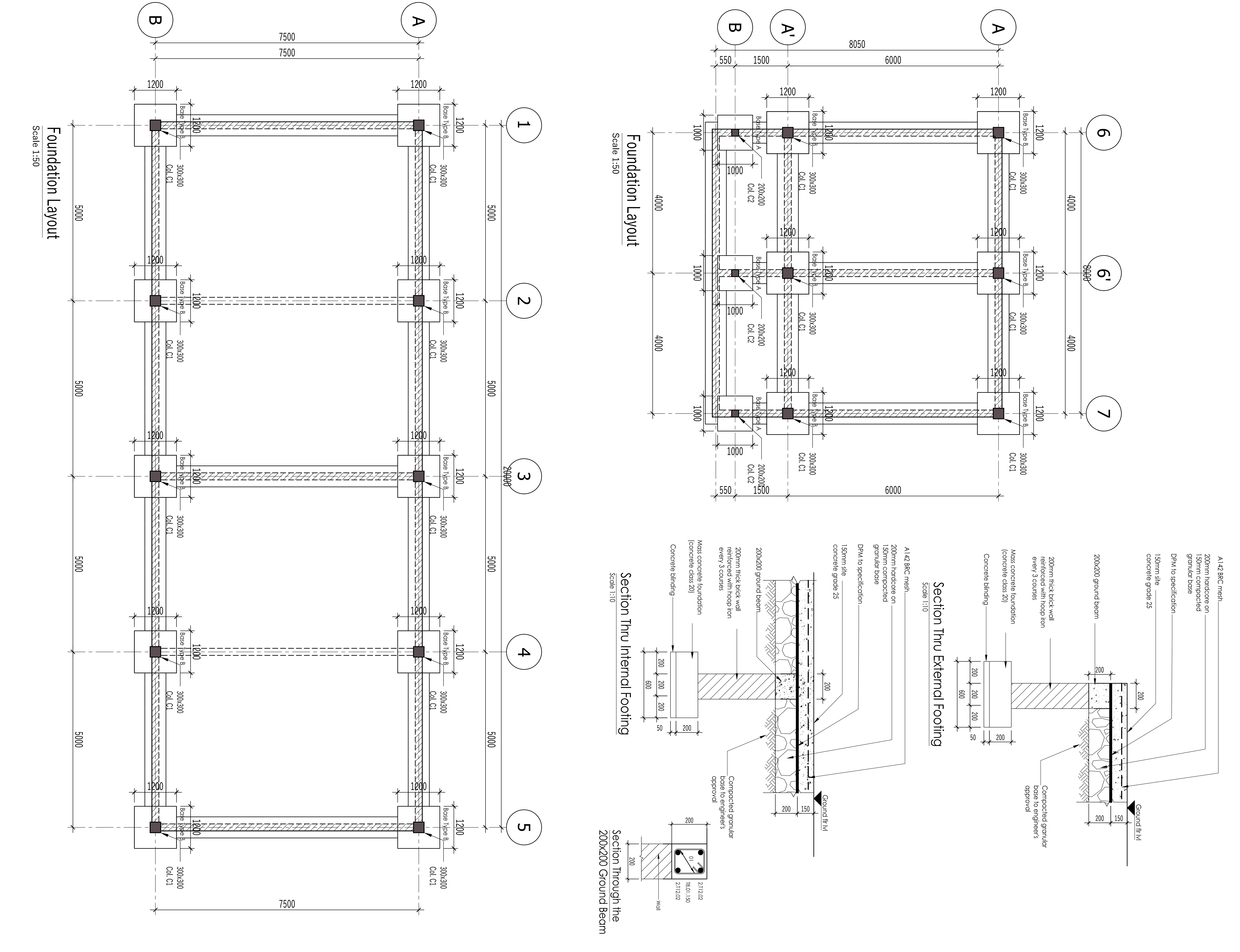
P.O.BOX 3694 KAMPALA

ARB.REG.No.257.

Drg. Title:

ELECTRICAL INSTALLATION LAYOUT.

Sheet no.: **EL/03**	Scale: **As Indicated**
Drawing no.:	Drawn by: **N.M.Z**
Units: **mm**	
Date: **DECEMBER 2024**	Checked by: **M.J.R**



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Proposed use	Grade	Permitted Aggregate type		Max.Agg size
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Proposed use	Cover
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Revision

No.	Date	Particulars	Initials

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ARCHITECT: MATOVU JOHN .R
P.O.BOX 3694 KAMPALA
ARB.REG.No.257.

CLIENT

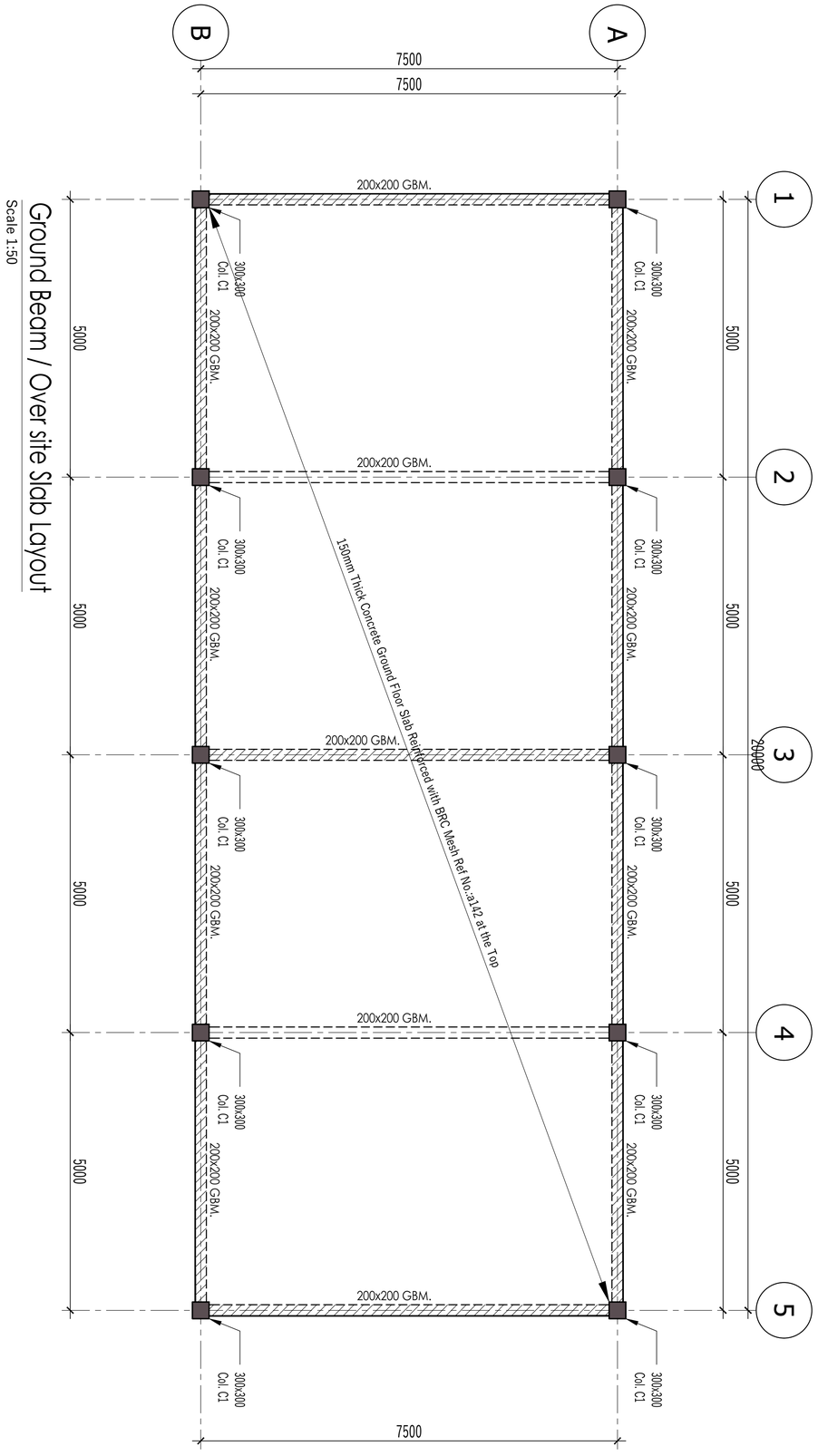
CENTRE FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT.

IGAD
ICPALD

SIGNATURE:

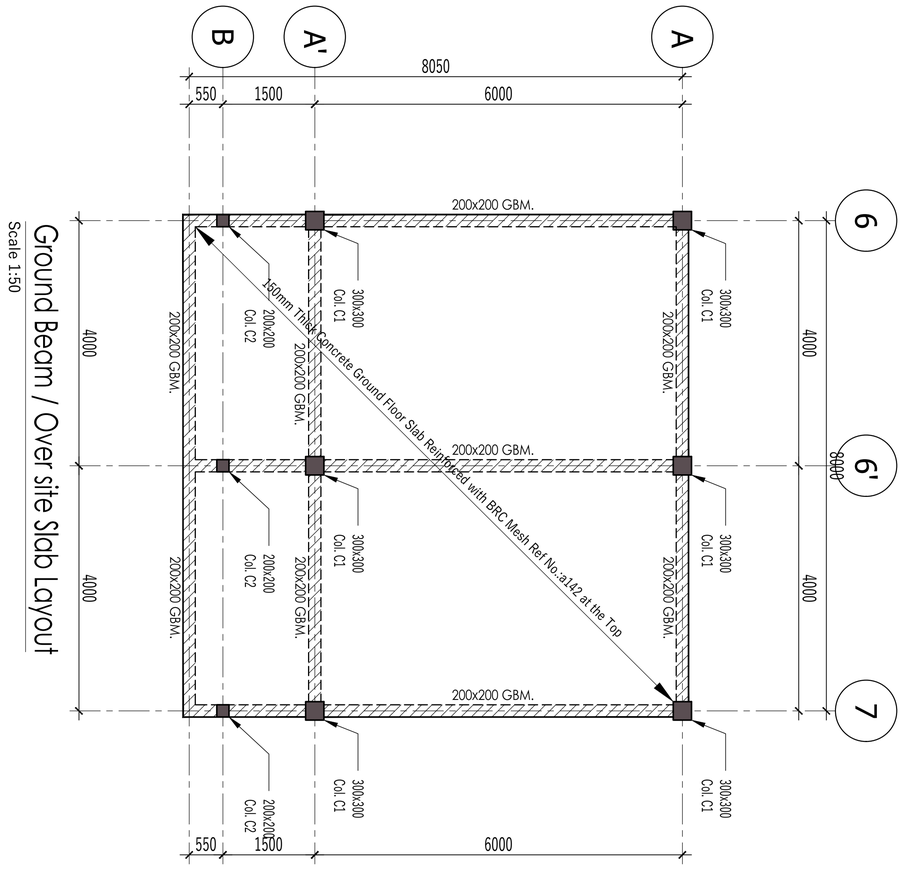
DRAWING STAGE	☐ TENDER DRAWINGS
	■ APRROVAL DRAWINGS
	☐ CONSTRUCTION DRAWINGS
DRAWING DESCRIPTION	Foundation Layout and Foundation Details
DRAWING NO.	STR.28.12.2024.A
SHEET NO.	S.01.A

SCALE	DATE	DRAWN BY	DESIGN BY	ENG. CHECKED BY
AS SHOWN	DEC. 2024	KK	KK	HMW



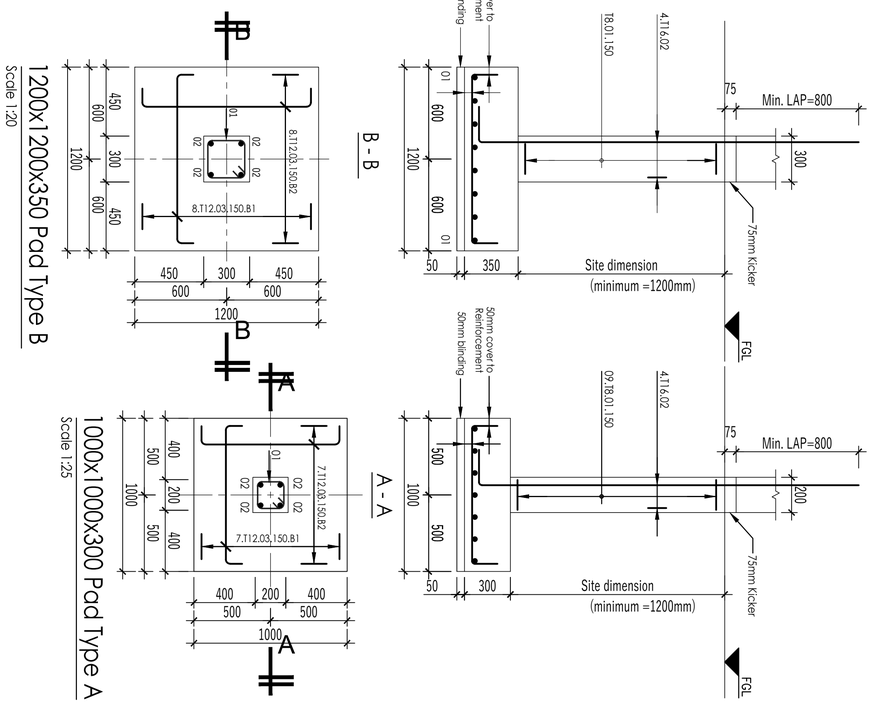
Ground Beam / Over site Slab Layout

Scale 1:50



Ground Beam / Over site Slab Layout

Scale 1:50



1200x1200x350 Pad Type B

Scale 1:20

1000x1000x300 Pad Type A

Scale 1:25

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PROPOSED POULTRY HOUSE LOCATED IN EKENDAYO IN THE REPUBLIC OF ETHIOPIA

ARCHITECT: MATOVU JOHN .R
P.O.BOX 3694 KAMPALA
ARB.REG.No.257.

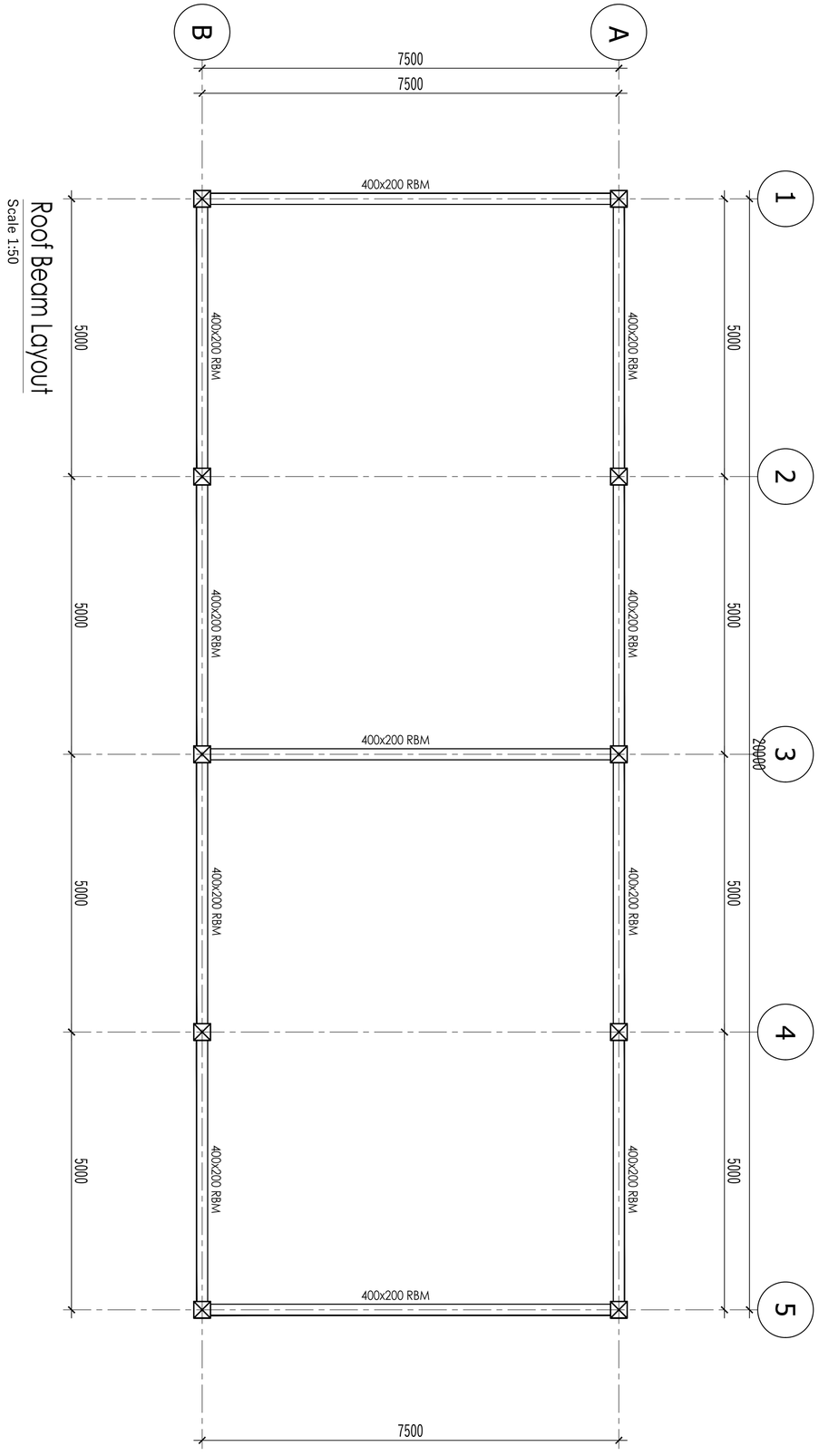
CLIENT
CENTRE FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT.

IGAD ICPALD

SIGNATURE:

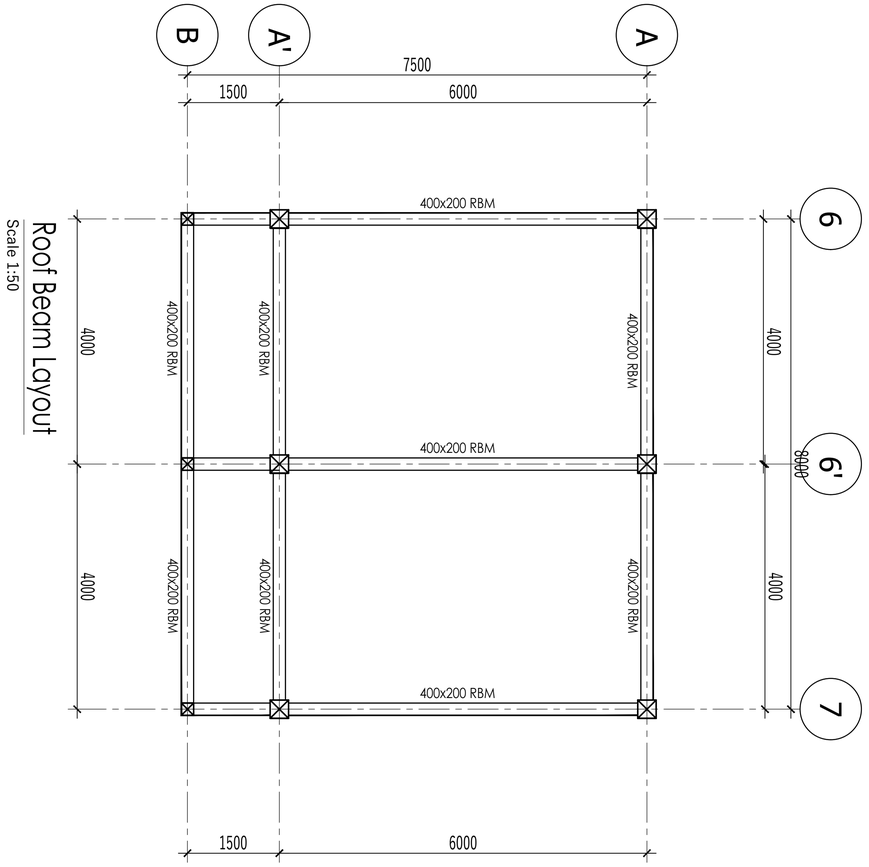
DRAWING STAGE	☐ TENDER DRAWINGS
	■ APRROVAL DRAWINGS
	☐ CONSTRUCTION DRAWINGS
DRAWING DESCRIPTION	Ground Beam / Over site Slab Layout and Bases, RC Details
DRAWING NO.	STR.28.12.2024.A
SHEET NO.	S.02.A

SCALE	DATE	DRAWN BY	DESIGN BY	ENG. CHECKED BY
AS SHOWN	DEC. 2024	KK	KK	HMW



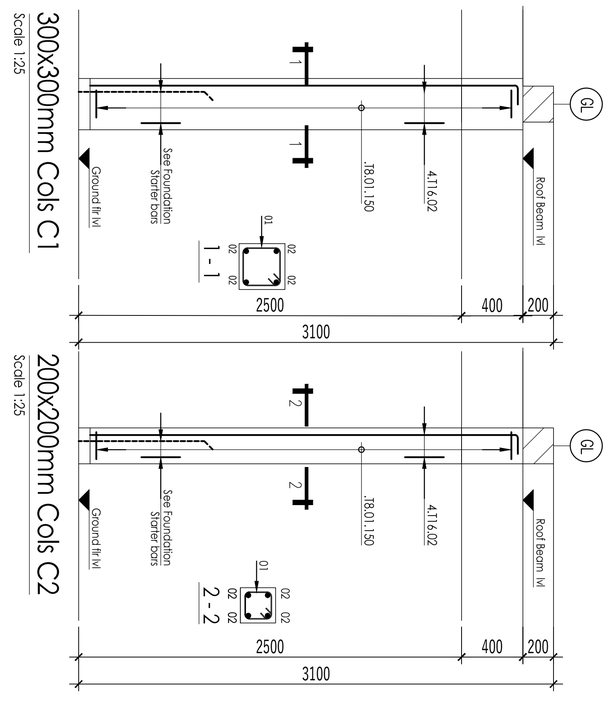
Roof Beam Layout

Scale 1:50



Roof Beam Layout

Scale 1:50

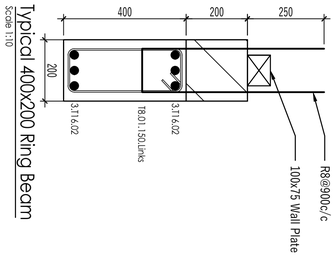


300x300mm Cols C1

Scale 1:25

200x200mm Cols C2

Scale 1:25



Typical 400x200 Ring Beam

Scale 1:10

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PROPOSED POULTRY HOUSE LOCATED IN EKENDAYO IN THE REPUBLIC OF ETHIOPIA

ARCHITECT: MATOVU JOHN .R
P.O.BOX 3694 KAMPALA
ARB.REG.No.257.

CLIENT

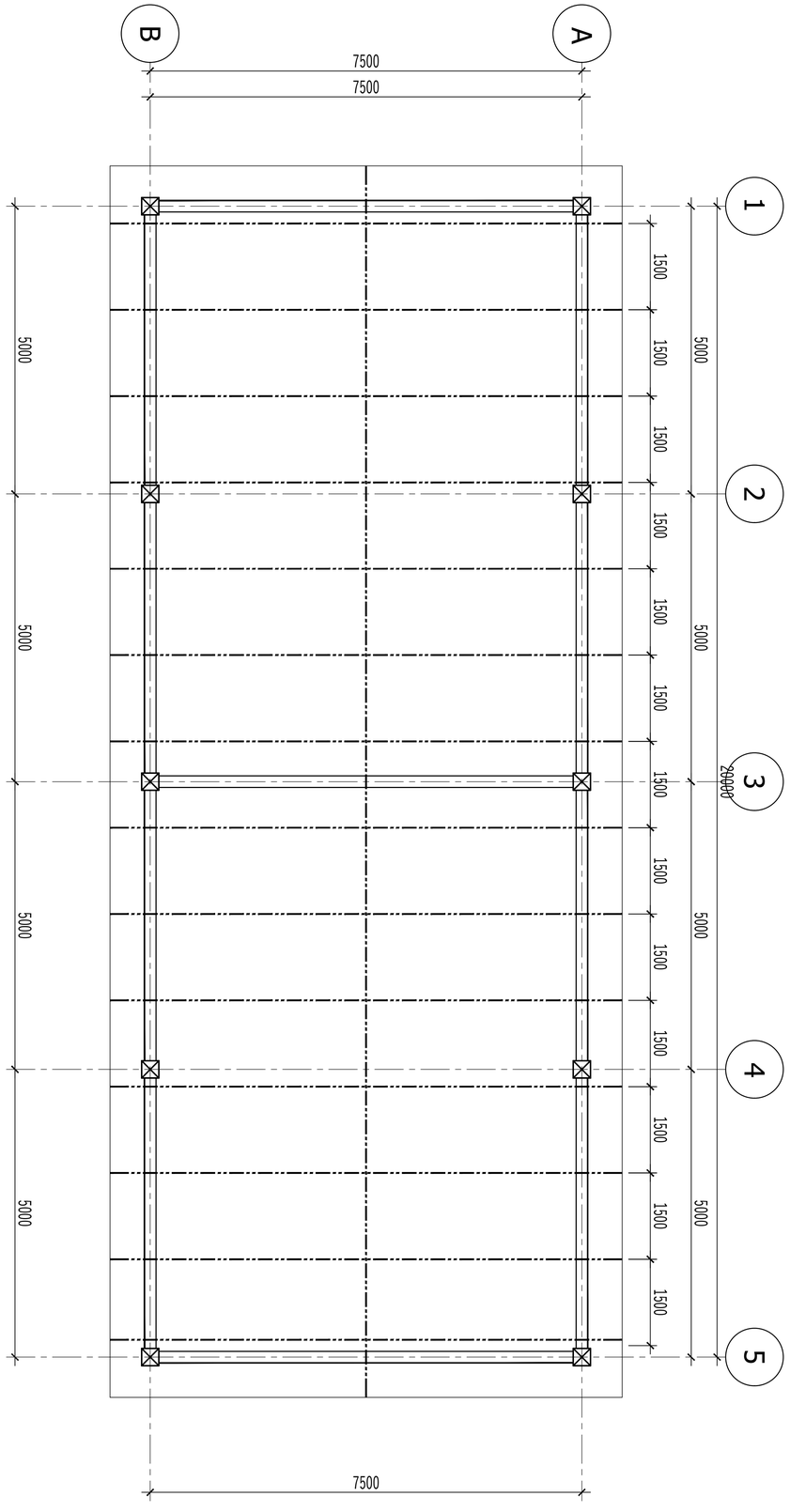
CENTRE FOR PASTORAL AREAS AND LIVESTOCK DEVELOPMENT.

IGAD ICPALD

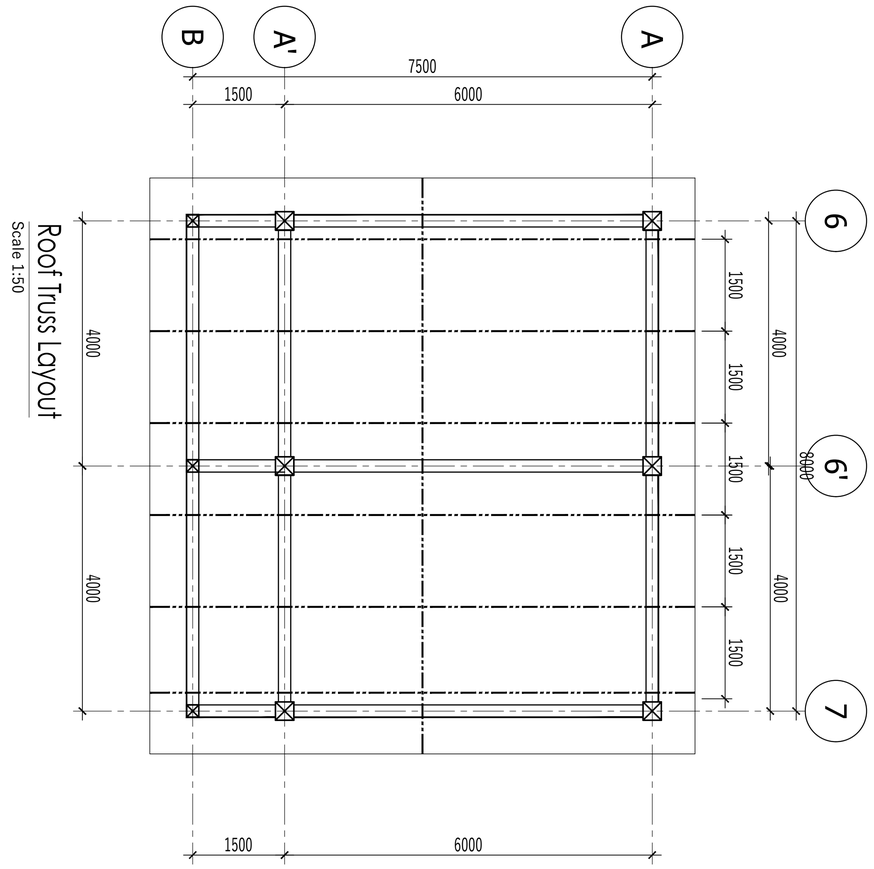
SIGNATURE:

DRAWING STAGE	☐ TENDER DRAWINGS
	■ APRROVAL DRAWINGS
	☐ CONSTRUCTION DRAWINGS
DRAWING DESCRIPTION	Roof Beam Layout
DRAWING NO.	STR.28.12.2024.A
SHEET NO.	S.03.A

SCALE	DATE	DRAWN BY	DESIGN BY	ENG. CHECKED BY
AS SHOWN	DEC. 2024	KK	KK	HMW



Roof Truss Layout
Scale 1:50



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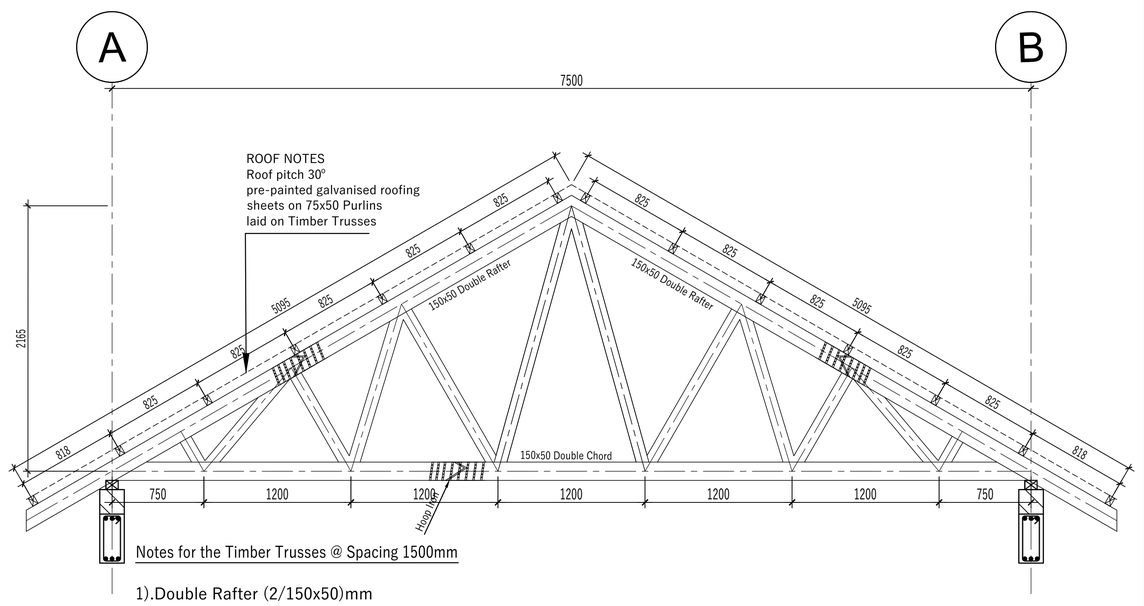
Scale 1:50



Notes for the Timber Trusses @ Spacing 1500mm

1).Double Rafter (2/150x50)mm

2). Ties & Struts (100x00)mm

3).Double Bottom Chord (2/150x50)mm

4).Purlins (75x50)mm @ 600mm

5).All Timber must be Treated

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IGAD ICPALD

SIGNATURE:

DRAWING STAGE	☐ TENDER DRAWINGS
	■ APPROVAL DRAWINGS
	☐ CONSTRUCTION DRAWINGS
DRAWING DESCRIPTION	Roof Truss Layout and Truss Details
DRAWING NO.	STR.28.12.2024.A
SHEET NO.	S.04.A

SCALE	DATE	DRAWN BY	DESIGN BY	ENG. CHECKED BY
AS SHOWN	DEC. 2024	KK	KK	HMW