KENYA MEDICAL TRAINING COLLEGE

TENDER NO. KMTC/59/2019-2020

PROPOSED CONSTRUCTION OF A TUITION BLOCK FOR KENYA MEDICAL TRAINING COLLEGE - KILIFI CAMPUS

CLOSING DATE: 14TH JULY, 2020 AT 10.00AM
BILLs OF QUANTITYs

SUPPLIED AS PART OF THE CONTRACT FOR

PROPOSED TUITION BLOCK TYPE 02

FOR

KENYA MEDICAL TRAINING COLLEGE

ISSUED BY :-

Marks & Ashton Consultants
Quantity Surveyors
P.O. Box 22637-00100
Nairobi, Kenya

This Contract Bills of Quantities comprises the following:

1. Volume I – Standard Tender Document for Procurement of Works (Building & Associated Civil Engineering Works) issued by the Public Procurement Oversight Authority 2007

2. Volume II – Bills of Quantities for Main Contract Works Only (Services Bills of Quantities shall be separate)
VOLUME I

Standard Tender Document for Procurement of Works (Building & Associated Civil Engineering Works) issued by the Public Procurement Oversight Authority 2007
VOLUME I

AGREEMENT & CONDITIONS
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INTRODUCTION

1.1 This standard tender document for procurement of works has been prepared for use by procuring entities in Kenya in the procurement of works (i.e. Buildings and associated Civil Engineering Works).

1.2 The following guidelines should be observed when using the document:-
(a) Specific details should be furnished in the Invitation to tender and in the special conditions of contract (where applicable). The tender document issued to tenderers should not have blank spaces or options.
(b) The instructions to tenderers and the General Conditions of Contract should remain unchanged. Any necessary amendments to these parts should be made through Appendix to instructions to tenderers and special conditions of contract respectively.

1.3 (b) Information contained in the invitation to tender shall conform to the data and information in the tender documents to enable prospective tenderers to decide whether or not to participate in the tender and shall indicate any important tender requirements.
(c) The invitation to tender shall be as an advertisement in accordance with the regulations or a letter of invitation addressed to tenderers who have been prequalified following a request for prequalification.

1.4 The cover of the document shall be modified to include:-

I. Tender number.
II. Tender name.
III. Name of procuring entity.
SECTION 1

INVITATION FOR TENDERS

Tender reference No. KMTC/59/2019-2020

Tender Name: PROPOSED CONSTRUCTION OF TUITION BLOCK AT K.M.T.C KILIFI CAMPUS

1.1 The Kenya Medical Training College invites sealed tenders for the Proposed Construction Of Tuition Block At K.M.T.C Kilifi Campus

1.2 Interested eligible candidates may obtain further information and inspect tender documents at KMTC Headquarters, Procurement office, Nairobi during normal working hours.

1.3 A complete set of tender documents may be obtained by interested candidates upon payment of a non-refundable fees of KShs. 1,000.00 in cash or Bankers Cheque or download from KMTC website; www.kmtc.ac.ke or http://tenders.go.ke at no cost.

1.4 Prices quoted should be net inclusive of all taxes, must be in Kenya shillings and shall remain valid for 120 days from the closing date of tender.

1.5 Completed tender documents are to be enclosed in plain sealed envelopes marked with Tender name and reference number and deposited in the Tender Box at situated at the entrance of the KMTC Administration Block, Headquarters Nairobi, so as to be received on or before 14th July, 2020 at 10.00 AM.

1.6 Tenders will be opened immediately thereafter in the presence of the candidates or their representatives who choose to attend at the Principal's Boardroom.

For (The Chief Executive Officer, Kenya Medical Training College)
### SECTION II

**INSTRUCTIONS TO TENDERERS**

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INSTRUCTIONS TO TENDERERS.

1. **General/Eligibility/Qualifications/Joint venture/Cost of tendering**

   1.1 The Employer as defined in the Appendix to Conditions of Contract invites tenders for Works Contract as described in the tender documents. The successful tenderer will be expected to complete the Works by the Intended Completion Date specified in the tender documents.

   1.2 All tenderers shall provide the Qualification Information, a statement that the tenderer (including all members of a joint venture and subcontractors) is not associated, or has not been associated in the past, directly or indirectly, with the Consultant or any other entity that has prepared the design, specifications, and other documents for the project or being proposed as Project Manager for the Contract. A firm that has been engaged by the Employer to provide consulting services for the preparation or supervision of the Works, and any of its affiliates, shall not be eligible to tender.

   1.3 All tenderers shall provide in the Form of Tender and Qualification Information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.

   1.4 In the event that pre-qualification of potential tenderers has been undertaken, only tenders from pre-qualified tenderers will be considered for award of Contract. These qualified tenderers should submit with their tenders any information updating their original pre-qualification applications or, alternatively, confirm in their tenders that the originally submitted pre-qualification information remains essentially correct as of the date of tender submission.

   1.5 Where no pre-qualification of potential tenderers has been done, all tenderers shall include the following information and documents with their tenders, unless otherwise stated:

   (a) copies of original documents defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of the signatory of the tender to commit the tenderer:

   (b) total monetary value of construction work performed for each of the last five years:

   (c) experience in works of a similar nature and size for each of the last five years, and details of work under way or contractually
committed; and names and addresses of clients who may be contacted for further information on these contracts;

(d) major items of construction equipment proposed to carry out the Contract and an undertaking that they will be available for the Contract.

(e) qualifications and experience of key site management and technical personnel proposed for the Contract and an undertaking that they shall be available for the Contract.

(f) reports on the financial standing of the tenderer, such as profit and loss statements and auditor’s reports for the past five years;

(g) evidence of adequacy of working capital for this Contract (access to line(s) of credit and availability of other financial resources);

(h) authority to seek references from the tenderer’s bankers;

(i) information regarding any litigation, current or during the last five years, in which the tenderer is involved, the parties concerned and disputed amount; and

(j) proposals for subcontracting components of the Works amounting to more than 10 percent of the Contract Price.

1.6 Tenders submitted by a joint venture of two or more firms as partners shall comply with the following requirements, unless otherwise stated:

(a) the tender shall include all the information listed in clause 1.5 above for each joint venture partner;

(b) the tender shall be signed so as to be legally binding on all partners;

(c) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;

(d) one of the partners will be nominated as being in charge, authorised to incur liabilities, and receive instructions for and on behalf of all partners of the joint venture; and

(e) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.
1.7 To qualify for award of the Contract, tenderers shall meet the following minimum qualifying criteria:

(a) annual volume of construction work of at least 2.5 times the estimated annual cashflow for the Contract;

(b) experience as main contractor in the construction of at least

(c) two works of a nature and complexity equivalent to the Works over the last 10 years (to comply with this requirement, works cited should be at least 70 percent complete);

(d) proposals for the timely acquisition (own, lease, hire, etc.) of the essential equipment listed as required for the Works;

(e) a Contract manager with at least five years’ experience in works of an equivalent nature and volume, including no less than three years as Manager; and

(f) liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of no less than 4 months of the estimated payment flow under this Contract.

1.8 The figures for each of the partners of a joint venture shall be added together to determine the tenderer’s compliance with the minimum qualifying criteria of clause 1.7 (a) and (e); however, for a joint venture to qualify, each of its partners must meet at least 25 percent of minimum criteria 1.7 (a), (b) and (e) for an individual tenderer, and the partner in charge at least 40 percent of those minimum criteria. Failure to comply with this requirement will result in rejection of the joint venture’s tender. Subcontractors’ experience and resources will not be taken into account in determining the tenderer’s compliance with the qualifying criteria, unless otherwise stated.

1.9 Each tenderer shall submit only one tender, either individually or as a partner in a joint venture. A tenderer who submits or participates in more than one tender (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the tenderer’s participation to be disqualified.

1.10 The tenderer shall bear all costs associated with the preparation and submission of his tender, and the Employer will in no case be responsible or liable for those costs.

1.11 The tenderer, at the tenderer’s own responsibility and risk, is encouraged to visit and examine the Site of the Works and its surroundings, and obtain all information that may be necessary for preparing the tender and entering into a contract for construction of
the Works. The costs of visiting the Site shall be at the tenderer’s own expense.

1.12 The procuring entity’s employees, committee members, board members and their relative (spouse and children) are not eligible to participate in the tender.

1.13 The price to be changed for the tender document shall not exceed Kshs.5,000/=.

1.14 The procuring entity shall allow the tenderer to review the tender document free of charge before purchase.

2. Tender Documents

2.1 The complete set of tender documents comprises the documents listed below and any addenda issued in accordance with Clause 2.4.

(a) These Instructions to Tenderers
(b) Form of Tender and Qualification Information
(c) Conditions of Contract
(d) Appendix to Conditions of Contract
(e) Specifications
(f) Drawings
(g) Bills of Quantities
(h) Forms of Securities

2.2 The tenderer shall examine all Instructions, Forms to be filled and Specifications in the tender documents. Failure to furnish all information required by the tender documents, or submission of a tender not substantially responsive to the tendering documents in every respect will be at the tenderer’s risk and may result in rejection of his tender.

2.3 A prospective tenderer making an inquiry relating to the tender documents may notify the Employer in writing or by cable, telex or facsimile at the address indicated in the letter of invitation to tender. The Employer will only respond to requests for clarification received earlier than seven days prior to the deadline for submission of tenders. Copies of the Employer’s response will be forwarded to all persons issued with tendering documents, including a description of the inquiry, but without identifying its source.

2.4 Before the deadline for submission of tenders, the Employer may modify the tendering documents by issuing addenda. Any addendum thus issued shall be part of the tendering documents and shall be communicated in writing or by cable, telex or facsimile to all tenderers. Prospective tenderers shall acknowledge receipt of each addendum in writing to the Employer.
2.5 To give prospective tenderers reasonable time in which to take an addendum into account in preparing their tenders, the Employer shall extend, as necessary, the deadline for submission of tenders, in accordance with Clause 4.2 here below.

3. Preparation of Tenders

3.1 All documents relating to the tender and any correspondence shall be in English language.

3.2 The tender submitted by the tenderer shall comprise the following:

(a) These Instructions to Tenderers, Form of Tender, Conditions of Contract, Appendix to Conditions of Contract and Specifications;

(b) Tender Security;

(c) Priced Bill of Quantities;

(d) Qualification Information Form and Documents;

(e) Alternative offers where invited; and

(f) Any other materials required to be completed and submitted by the tenderers.

3.3 The tenderer shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items for which no rate or price is entered by the tenderer will not be paid for when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities. All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause relevant to the Contract, as of 30 days prior to the deadline for submission of tenders, shall be included in the tender price submitted by the tenderer.

3.4 The rates and prices quoted by the tenderer shall only be subject to adjustment during the performance of the Contract if provided for in the Appendix to Conditions of Contract and provisions made in the Conditions of Contract.

3.5 The unit rates and prices shall be in Kenya Shillings.

3.6 Tenders shall remain valid for a period of sixty (60) days from the date of submission. However, in exceptional circumstances, the Employer may request that the tenderers extend the period of validity for a
specified additional period. The request and the tenderers' responses shall be made in writing. A tenderer may refuse the request without forfeiting the Tender Security. A tenderer agreeing to the request will not be required or permitted to otherwise modify the tender, but will be required to extend the validity of Tender Security for the period of the extension, and in compliance with Clause 3.7 - 3.11 in all respects.

3.7 The tenderer shall furnish, as part of the tender, a Tender Security in the amount and form specified in the appendix to invitation to tenderers. This shall be in the amount not exceeding 2 percent of the tender price.

3.8 The format of the Tender Security should be in accordance with the form of Tender Security included in Section G - Standard forms or any other form acceptable to the Employer. Tender Security shall be valid for 30 days beyond the validity of the tender.

3.9 Any tender not accompanied by an acceptable Tender Security shall be rejected. The Tender Security of a joint venture must define as “Tenderer” all joint venture partners and list them in the following manner: a joint venture consisting of “............”, “..............”, and “............”.

3.10 The Tender Securities of unsuccessful tenderers will be returned within 28 days of the end of the tender validity period specified in Clause 3.6.

3.11 The Tender Security of the successful tenderer will be discharged when the tenderer has signed the Contract Agreement and furnished the required Performance Security.

3.12 The Tender Security may be forfeited

(a) if the tenderer withdraws the tender after tender opening during the period of tender validity;

(b) if the tenderer does not accept the correction of the tender price, pursuant to Clause 5.7;

(c) in the case of a successful tenderer, if the tenderer fails within the specified time limit to

(i) sign the Agreement, or

(ii) furnish the required Performance Security.

3.13 Tenderers shall submit offers that comply with the requirements of the tendering documents, including the basic technical design as indicated in the Drawings and Specifications. Alternatives will not be
considered, unless specifically allowed in the invitation to tender. If so allowed, tenderers wishing to offer technical alternatives to the requirements of the tendering documents must also submit a tender that complies with the requirements of the tendering documents, including the basic technical design as indicated in the Drawings and Specifications. In addition to submitting the basic tender, the tenderer shall provide all information necessary for a complete evaluation of the alternative, including design calculations, technical specifications, breakdown of prices, proposed construction methods and other relevant details. Only the technical alternatives, if any, of the lowest evaluated tender conforming to the basic technical requirements shall be considered.

3.14 The tenderer shall prepare one original of the documents comprising the tender documents as described in Clause 3.2 of these Instructions to Tenderers, bound with the volume containing the Form of Tender, and clearly marked “ORIGINAL”. In addition, the tenderer shall submit copies of the tender, in the number specified in the invitation to tender, and clearly marked as “COPIES”. In the event of discrepancy between them, the original shall prevail.

3.15 The original and all copies of the tender shall be typed or written in indelible ink and shall be signed by a person or persons duly authorised to sign on behalf of the tenderer, pursuant to Clause 1.5 (a) or 1.6 (b), as the case may be. All pages of the tender where alterations or additions have been made shall be initialled by the person or persons signing the tender.

3.16 Clarification of tenders shall be requested by the tenderer to be received by the procuring entity not later than 7 days prior to the deadline for submission of tenders.

3.17 The procuring entity shall reply to any clarifications sought by the tenderer within 3 days of receiving the request to enable the tenderer to make timely submission of its tender.

3.18 The tender security shall be in the amount of 0.5 – 2 per cent of the tender price.

4. Submission of Tenders

4.1 The tenderer shall seal the original and all copies of the tender in two inner envelopes and one outer envelope, duly marking the inner envelopes as “ORIGINAL” and “COPIES” as appropriate. The inner and outer envelopes shall:

(a) be addressed to the Employer at the address provided in the invitation to tender;
(b) bear the name and identification number of the Contract as defined in the invitation to tender; and

(c) provide a warning not to open before the specified time and date for tender opening.

4.2 Tenders shall be delivered to the Employer at the address specified above not later than the time and date specified in the invitation to tender. However, the Employer may extend the deadline for submission of tenders by issuing an amendment in accordance with Sub-Clause 2.5 in which case all rights and obligations of the Employer and the tenderers previously subject to the original deadline will then be subject to the new deadline.

4.3 Any tender received after the deadline prescribed in clause 4.2 will be returned to the tenderer un-opened.

4.4 Tenderers may modify or withdraw their tenders by giving notice in writing before the deadline prescribed in clause 4.2. Each tenderer’s modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with clause 3.13 and 4.1, with the outer and inner envelopes additionally marked “MODIFICATION” and “WITHDRAWAL”, as appropriate. No tender may be modified after the deadline for submission of tenders.

4.5 Withdrawal of a tender between the deadline for submission of tenders and the expiration of the period of tender validity specified in the invitation to tender or as extended pursuant to Clause 3.6 may result in the forfeiture of the Tender Security pursuant to Clause 3.11.

4.6 Tenderers may only offer discounts to, or otherwise modify the prices of their tenders by submitting tender modifications in accordance with Clause 4.4 or be included in the original tender submission.

5. Tender Opening and Evaluation

5.1 The tenders will be opened by the Employer, including modifications made pursuant to Clause 4.4, in the presence of the tenderers’ representatives who choose to attend at the time and in the place specified in the invitation to tender. Envelopes marked “WITHDRAWAL” shall be opened and read out first. Tenderers’ and Employer’s representatives who are present during the opening shall sign a register evidencing their attendance.

5.2 The tenderers’ names, the tender prices, the total amount of each tender and of any alternative tender (if alternatives have been requested or permitted), any discounts, tender modifications and withdrawals, the presence or absence of Tender Security, and such other details as may be considered appropriate, will be announced by
the Employer at the opening. Minutes of the tender opening, including
the information disclosed to those present will be prepared by the
Employer.

5.3 Information relating to the examination, clarification, evaluation, and
comparison of tenders and recommendations for the award of Contract
shall not be disclosed to tenderers or any other persons not officially
concerned with such process until the award to the successful tenderer
has been announced. Any effort by a tenderer to influence the
Employer's officials, processing of tenders or award decisions may
result in the rejection of his tender.

5.4 To assist in the examination, evaluation, and comparison of tenders, the
Employer at his discretion, may ask any tenderer for clarification of
the tender, including breakdowns of unit rates. The request for clarification
and the response shall be in writing or by cable, telex or facsimile but no
change in the price or substance of the tender shall be sought, offered,
or permitted except as required to confirm the correction of arithmetic
errors discovered in the evaluation of the tenders in accordance with
Clause 5.7.

5.5 Prior to the detailed evaluation of tenders, the Employer will determine
whether each tender (a) meets the eligibility criteria defined in Clause
1.7; (b) has been properly signed; (c) is accompanied by the required
securities; and (d) is substantially responsive to the requirements of the
tendering documents. A substantially responsive tender is one which
conforms to all the terms, conditions and specifications of the tendering
documents, without material deviation or reservation. A material
deviation or reservation is one (a) which affects in any substantial way
the scope, quality, or performance of the works; (b) which limits in any
substantial way, inconsistent with the tendering documents, the
Employer's rights or the tenderer's obligations under the Contract; or
(c) whose rectification would affect unfairly the competitive position of
other tenderers presenting substantially responsive tenders.

5.6 If a tender is not substantially responsive, it will be rejected, and may
not subsequently be made responsive by correction or withdrawal of the
nonconforming deviation or reservation.

5.7 Tenders determined to be substantially responsive will be checked for
any arithmetic errors. Errors will be corrected as follows:

(a) where there is a discrepancy between the amount in figures and
the amount in words, the amount in words will prevail; and

(b) where there is a discrepancy between the unit rate and the line
item total resulting from multiplying the unit rate by the quantity,
the unit rate as quoted will prevail, unless in the opinion of the
Employer, there is an obvious typographical
error, in which case the adjustment will be made to the entry containing that error.

(c) In the event of a discrepancy between the tender amount as stated in the Form of Tender and the corrected tender figure in the main summary of the Bill of Quantities, the amount as stated in the Form of Tender shall prevail.

(d) The Error Correction Factor shall be computed by expressing the difference between the tender amount and the corrected tender sum as a percentage of the corrected Builder’s Work (i.e. Corrected tender sum less P.C. and Provisional Sums)

(e) The Error Correction Factor shall be applied to all Builder’s Work (as a rebate or addition as the case may be) for the purposes of valuations for Interim Certificates and valuation of variations.

(f) the amount stated in the tender will be adjusted in accordance with the above procedure for the correction of errors and, with concurrence of the tenderer, shall be considered as binding upon the tenderer. If the tenderer does not accept the corrected amount, the tender may be rejected and the Tender Security may be forfeited in accordance with clause 3.11.

5.8 The Employer will evaluate and compare only the tenders determined to be substantially responsive in accordance with Clause 5.5.

5.9 In evaluating the tenders, the Employer will determine for each tender the evaluated tender price by adjusting the tender price as follows:

(a) making any correction for errors pursuant to clause 5.7;

(b) excluding provisional sums and the provision, if any, for contingencies in the Bill of Quantities, but including Dayworks where priced competitively.

(c) making an appropriate adjustment for any other acceptable variations, deviations, or alternative offers submitted in accordance with clause 3.12; and

(d) making appropriate adjustments to reflect discounts or other price modifications offered in accordance with clause 4.6

5.10 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the tender documents or otherwise result in unsolicited benefits for the Employer will not be taken into account in tender evaluation.
5.11 The tenderer shall not influence the Employer on any matter relating to his tender from the time of the tender opening to the time the Contract is awarded. Any effort by the Tenderer to influence the Employer or his employees in his decision on tender evaluation, tender comparison or Contract award may result in the rejection of the tender.

5.12 Firms incorporated in Kenya where indigenous Kenyans own 51% or more of the share capital shall be allowed a 10% preferential bias provided that they do not sub-contract work valued at more than 50% of the Contract Price excluding Provisional Sums to an non-indigenous sub-contractor.

6. Award of Contract

6.1 Subject to Clause 6.2, the award of the Contract will be made to the tenderer whose tender has been determined to be substantially responsive to the tendering documents and who has offered the lowest evaluated tender price, provided that such tenderer has been determined to be (a) eligible in accordance with the provision of Clauses 1.2, and (b) qualified in accordance with the provisions of clause 1.7 and 1.8.

6.2 Notwithstanding clause 6.1 above, the Employer reserves the right to accept or reject any tender, and to cancel the tendering process and reject all tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected tenderer or tenderers or any obligation to inform the affected tenderer or tenderers of the grounds for the action.

6.3 The tenderer whose tender has been accepted will be notified of the award prior to expiration of the tender validity period in writing or by cable, telex or facsimile. This notification (hereinafter and in all Contract documents called the “Letter of Acceptance”) will state the sum (hereinafter and in all Contract documents called the “Contract Price”) that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract. At the same time the other tenderers shall be informed that their tenders have not been successful.

The contract shall be formed on the parties signing the contract.

6.4 The Agreement will incorporate all agreements between the Employer and the successful tenderer. Within 14 days of receipt the successful tenderer will sign the Agreement and return it to the Employer.

6.5 Within 21 days after receipt of the Letter of Acceptance, the successful tenderer shall deliver to the Employer a Performance Security in the amount stipulated in the Appendix to Conditions of Contract and in
the form stipulated in the Tender documents. The Performance Security shall be in the amount and specified form.

6.6 Failure of the successful tenderer to comply with the requirements of clause 6.5 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Tender Security.

6.7 Upon the furnishing by the successful tenderer of the Performance Security, the Employer will promptly notify the other tenderers that their tenders have been unsuccessful.

6.8 Preference where allowed in the evaluation of tenders shall not be allowed for contracts not exceeding one year (12 months)

6.9 The tender evaluation committee shall evaluate the tender within 30 days of the validity period from the date of opening the tender.

6.10 The parties to the contract shall have it signed within 30 days from the date of notification of contract award unless there is an administrative review request.

6.11 Contract price variations shall not be allowed for contracts not exceeding one year (12 months)

6.12 Where contract price variation is allowed, the valuation shall not exceed 15% of the original contract price.

6.13 Price variation request shall be processed by the procuring entity within 30 days of receiving the request.

6.14 The procuring entity may at any time terminate procurement proceedings before contract award and shall not be liable to any person for the termination.

6.15 The procuring entity shall give prompt notice of the termination to the tenderers and on request give its reasons for termination within 14 days of receiving the request from any tenderer.

6.16 A tenderer who gives false information in the tender document about its qualification or who refuses to enter into a contract after notification of contract award shall be considered for debarment from participating in future public procurement.

7. **Corrupt and Fraudulent practices**

7.1 The procuring entity requires that tenderers observe the highest standards of ethics during procurement process and execution of contracts. A tenderer shall sign a declaration that he has not and will not be involved in corrupt and fraudulent practices.
SECTION III CONDITIONS OF CONTRACT

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1. Definitions

1.1 In this Contract, except where context otherwise requires, the following terms shall be interpreted as indicated:

“Bill of Quantities” means the priced and completed Bill of Quantities forming part of the tender.

“Compensation Events” are those defined in Clause 24 hereunder.

“The Completion Date” means the date of completion of the Works as certified by the Project Manager, in accordance with Clause 31.

“The Contract” means the agreement entered into between the Employer and the Contractor as recorded in the Agreement Form and signed by the parties including all attachments and appendices thereto and all documents incorporated by reference therein to execute, complete, and maintain the Works.

“The Contractor” refers to the person or corporate body whose tender to carry out the Works has been accepted by the Employer.

“The Contractor’s Tender” is the completed tendering document submitted by the Contractor to the Employer.

“The Contract Price” is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

“Days” are calendar days; “Months” are calendar months.

“A Defect” is any part of the Works not completed in accordance with the Contract.

“The Defects Liability Certificate” is the certificate issued by Project Manager upon correction of defects by the Contractor.

“The Defects Liability Period” is the period named in the Contract Data and calculated from the Completion Date.

“Drawings” include calculations and other information provided or approved by the Project Manager for the execution of the Contract.

“Dayworks” are Work inputs subject to payment on a time basis for labour and the associated materials and plant.
“Employer”, or the “Procuring entity” as defined in the Public Procurement Regulations (i.e. Central or Local Government administration, Universities, Public Institutions and Corporations, etc) is the party who employs the Contractor to carry out the Works.

“Equipment” is the Contractor’s machinery and vehicles brought temporarily to the Site for the execution of the Works.

“The Intended Completion Date” is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.

“Materials” are all supplies, including consumables, used by the Contractor for incorporation in the Works.

“Plant” is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

“Project Manager” is the person named in the Appendix to Conditions of Contract (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract and shall be an “Architect” or a “Quantity Surveyor” registered under the Architects and Quantity Surveyors Act Cap 525 or an “Engineer” registered under Engineers Registration Act Cap 530.

“Site” is the area defined as such in the Appendix to Condition of Contract.

“Site Investigation Reports” are those reports that may be included in the tendering documents which are factual and interpretative about the surface and subsurface conditions at the Site.

“Specifications” means the Specifications of the Works included in the Contract and any modification or addition made or approved by the Project Manager.

“Start Date” is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with the Site possession date(s).

“A Subcontractor” is a person or corporate body who has a Contract with the Contractor to carry out a part of the Work in the Contract, which includes Work on the Site.

“Temporary works” are works designed, constructed, installed, and removed by the Contractor which are needed for construction or installation of the Works.
“**A Variation**” is an instruction given by the Project Manager which varies the Works.

“**The Works**” are what the Contract requires the Contractor to construct, install, and turnover to the Employer, as defined in the Appendix to Conditions of Contract.

2. **Interpretation**

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning in English Language unless specifically defined. The Project Manager will provide instructions clarifying queries about these Conditions of Contract.

2.2 If sectional completion is specified in the Appendix to Conditions of Contract, reference in the Conditions of Contract to the Works, the Completion Date and the Intended Completion Date apply to any section of the Works (other than references to the Intended Completion Date for the whole of the Works).

2.3 The following documents shall constitute the Contract documents and shall be interpreted in the following order of priority;

1. Agreement,
2. Letter of Acceptance,
3. Contractor’s Tender,
4. Appendix to Conditions of Contract,
5. Conditions of Contract,
6. Specifications,
7. Drawings,
8. Bill of Quantities,
9. Any other documents listed in the Appendix to Conditions of Contract as forming part of the Contract.

Immediately after the execution of the Contract, the Project Manager shall furnish both the Employer and the Contractor with two copies each of all the Contract documents. Further, as and when necessary the Project Manager shall furnish the Contractor [always with a copy to the Employer] with three [3] copies of such further drawings or
details or descriptive schedules as are reasonably necessary either
to explain or amplify the Contract drawings or to enable the
Contractor to carry out and complete the Works in accordance with
these Conditions.

3. Language and Law

3.1 Language of the Contract and the law governing the Contract shall be
English language and the Laws of Kenya respectively unless
otherwise stated.

4 Project Manager’s Decisions

4.1 Except where otherwise specifically stated, the Project Manager will
decide contractual matters between the Employer and the Contractor in
the role representing the Employer.

5 Delegation

5.1 The Project Manager may delegate any of his duties and responsibilities
to others after notifying the Contractor.

6 Communications

6.1 Communication between parties shall be effective only when in writing.
A notice shall be effective only when it is delivered.

7 Subcontracting

7.1 The Contractor may subcontract with the approval of the Project
Manager, but may not assign the Contract without the approval of the
Employer in writing. Subcontracting shall not alter the Contractor’s
obligations.

8 Other Contractors

8.1 The Contractor shall cooperate and share the Site with other
contractors, public authorities, utilities etc. as listed in the Appendix to
Conditions of Contract and also with the Employer, as per the directions
of the Project Manager. The Contractor shall also provide facilities and
services for them. The Employer may modify the said List of Other
Contractors etc., and shall notify the Contractor of any such
modification.

9 Personnel

9.1 The Contractor shall employ the key personnel named in the
Qualification Information, to carry out the functions stated in the said
Information or other personnel approved by the Project Manager. The
Project Manager will approve any proposed replacement of key

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personnel only if their relevant qualifications and abilities are substantially equal to or better than those of the personnel listed in the Qualification Information. If the Project Manager asks the Contractor to remove a person who is a member of the Contractor’s staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the Work in the Contract.

10 Works

10.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings. The Works may commence on the Start Date and shall be carried out in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.

11 Safety and Temporary Works

11.1 The Contractor shall be responsible for the design of temporary works. However before erecting the same, he shall submit his designs including specifications and drawings to the Project Manager and to any other relevant third parties for their approval. No erection of temporary works shall be done until such approvals are obtained.

11.2 The Project Manager’s approval shall not alter the Contractor’s responsibility for design of the Temporary works and all drawings prepared by the Contractor for the execution of the temporary or permanent Works, shall be subject to prior approval by the Project Manager before they can be used.

11.3 The Contractor shall be responsible for the safety of all activities on the Site.

12. Discoveries

12.1 Anything of historical or other interest or of significant value unexpectedly discovered on Site shall be the property of the Employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager’s instructions for dealing with them.

13. Work Program

13.1 Within the time stated in the Appendix to Conditions of Contract, the Contractor shall submit to the Project Manager for approval a program showing the general methods, arrangements, order, and timing for all the activities in the Works. An update of the program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the
remaining Work, including any changes to the sequence of the activities.

The Contractor shall submit to the Project Manager for approval an updated program at intervals no longer than the period stated in the Appendix to Conditions of Contract. If the Contractor does not submit an updated program within this period, the Project Manager may withhold the amount stated in the said Appendix from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue program has been submitted. The Project Manager’s approval of the program shall not alter the Contractor’s obligations. The Contractor may revise the program and submit it to the Project Manager again at any time. A revised program shall show the effect of Variations and Compensation Events.

14. Possession of Site

14.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Appendix to Conditions of Contract, the Employer will be deemed to have delayed the start of the relevant activities, and this will be a Compensation Event.

15. Access to Site

15.1 The Contractor shall allow the Project Manager and any other person authorised by the Project Manager, access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

16. Instructions

16.1 The Contractor shall carry out all instructions of the Project Manager which are in accordance with the Contract.

17. Extension or Acceleration of Completion Date

17.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a variation is issued which makes it impossible for completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining Work, which would cause the Contractor to incur additional cost. The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager in writing for a decision upon the effect of a Compensation Event or variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay
17.2 No bonus for early completion of the Works shall be paid to the Contractor by the Employer.

18. Management Meetings

18.1 A Contract management meeting shall be held monthly and attended by the Project Manager and the Contractor. Its business shall be to review the plans for the remaining Work and to deal with matters raised in accordance with the early warning procedure. The Project Manager shall record the minutes of management meetings and provide copies of the same to those attending the meeting and the Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

19. Early Warning

19.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the Work, increase the Contract Price or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

19.2 The Contractor shall cooperate with the Project Manager in making and considering proposals on how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the Work and in carrying out any resulting instructions of the Project Manager.

20. Defects

20.1 The Project Manager shall inspect the Contractor’s work and notify the Contractor of any defects that are found. Such inspection shall not affect the Contractor’s responsibilities. The Project Manager may instruct the Contractor to search for a defect and to uncover and test any Work that the Project Manager considers may have a defect. Should the defect be found, the cost of uncovering and making good shall be borne by the Contractor. However, if there is no defect found, the cost of uncovering and making good shall be treated as a variation and added to the Contract Price.

20.2 The Project Manager shall give notice to the Contractor of any defects.
before the end of the Defects Liability Period, which begins at Completion, and is defined in the Appendix to Conditions of Contract. The Defects Liability Period shall be extended for as long as defects remain to be corrected.

20.3 Every time notice of a defect is given, the Contractor shall correct the notified defect within the length of time specified by the Project Manager’s notice. If the Contractor has not corrected a defect within the time specified in the Project Manager’s notice, the Project Manager will assess the cost of having the defect corrected by other parties and such cost shall be treated as a variation and be deducted from the Contract Price.

21. Bills Of Quantities

21.1 The Bills of Quantities shall contain items for the construction, installation, testing and commissioning of the Work to be done by the Contractor. The Contractor will be paid for the quantity of the Work done at the rate in the Bills of Quantities for each item.

21.2 If the final quantity of the Work done differs from the quantity in the Bills of Quantities for the particular item by more than 25 percent and provided the change exceeds 1 percent of the Initial Contract price, the Project Manager shall adjust the rate to allow for the change.

21.3 If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bills of Quantities.

22. Variations

22.1 All variations shall be included in updated programs produced by the Contractor.

22.2 The Contractor shall provide the Project Manager with a quotation for carrying out the variations when requested to do so. The Project Manager shall assess the quotation, which shall be given within seven days of the request or within any longer period as may be stated by the Project Manager and before the Variation is ordered.

22.3 If the work in the variation corresponds with an item description in the Bills of Quantities and if in the opinion of the Project Manager, the quantity of work is not above the limit stated in Clause 21.2 or the timing of its execution does not cause the cost per unit of quantity to change, the rate in the Bills of Quantities shall be used to calculate the value of the variation. If the cost per unit of quantity changes, or
if the nature or timing of the work in the variation does not correspond with items in the Bills of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of Work.

22.4 If the Contractor’s quotation is unreasonable, the Project Manager may order the variation and make a change to the Contract price, which shall be based on the Project Manager’s own forecast of the effects of the variation on the Contractor’s costs.

22.5 If the Project Manager decides that the urgency of varying the Work would prevent a quotation being given and considered without delaying the Work, no quotation shall be given and the variation shall be treated as a Compensation Event.

22.6 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

22.7 When the Program is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast.

23. **Payment Certificates, Currency of Payments and Advance Payments**

23.1 The Contractor shall submit to the Project Manager monthly applications for payment giving sufficient details of the Work done and materials on Site and the amounts which the Contractor considers himself to be entitled to. The Project Manager shall check the monthly application and certify the amount to be paid to the Contractor within 14 days. The value of Work executed and payable shall be determined by the Project Manager.

23.2 The value of Work executed shall comprise the value of the quantities of the items in the Bills of Quantities completed, materials delivered on Site, variations and compensation events. Such materials shall become the property of the Employer once the Employer has paid the Contractor for their value. Thereafter, they shall not be removed from Site without the Project Manager’s instructions except for use upon the Works.

23.3 Payments shall be adjusted for deductions for retention. The Employer shall pay the Contractor the amounts certified by the Project Manager within 30 days of the date of issue of each certificate. If the Employer makes a late payment, the Contractor shall be paid simple interest on the late payment in the next payment. Interest shall be calculated on the basis of number of days delayed at a rate three percentage points above the Central Bank of Kenya’s average rate for base lending prevailing as of the first day the payment becomes overdue.
23.4 If an amount certified is increased in a later certificate or as a result of an award by an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

23.5 Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

23.6 The Contract Price shall be stated in Kenya Shillings. All payments to the Contractor shall be made in Kenya Shillings and foreign currency in the proportion indicated in the tender, or agreed prior to the execution of the Contract Agreement and indicated therein. The rate of exchange for the calculation of the amount of foreign currency payment shall be the rate of exchange indicated in the Appendix to Conditions of Contract. If the Contractor indicated foreign currencies for payment other than the currencies of the countries of origin of related goods and services the Employer reserves the right to pay the equivalent at the time of payment in the currencies of the countries of such goods and services. The Employer and the Project Manager shall be notified promptly by the Contractor of any changes in the expected foreign currency requirements of the Contractor during the execution of the Works as indicated in the Schedule of Foreign Currency Requirements and the foreign and local currency portions of the balance of the Contract Price shall then be amended by agreement between Employer and the Contractor in order to reflect appropriately such changes.

23.7 In the event that an advance payment is granted, the following shall apply:-

   a) On signature of the Contract, the Contractor shall at his request, and without furnishing proof of expenditure, be entitled to an advance of 10% (ten percent) of the original amount of the Contract. The advance shall not be subject to retention money.

   b) No advance payment may be made before the Contractor has submitted proof of the establishment of deposit or a directly liable guarantee satisfactory to the Employer in the amount of the advance. The guarantee shall be in the same currency as the advance.

   c) Reimbursement of the lump sum advance shall be made by deductions from the Interim payments and where applicable from the balance owing to the Contractor. Reimbursement shall begin when the amount of the sums due under the Contract reaches 20% of the original amount of the Contract.
shall have been completed by the time 80% of this amount is reached.

The amount to be repaid by way of successive deductions shall be calculated by means of the formula:

\[ R = \frac{A(x_1 - x_{ii})}{80 - 20} \]

Where:

- \( R \) = the amount to be reimbursed
- \( A \) = the amount of the advance which has been granted
- \( x_1 \) = the amount of proposed cumulative payments as a percentage of the original amount of the Contract. This figure will exceed 20% but not exceed 80%.
- \( x_{ii} \) = the amount of the previous cumulative payments as a percentage of the original amount of the Contract. This figure will be below 80% but not less than 20%.

\[ d) \quad \text{with each reimbursement the counterpart of the directly liable guarantee may be reduced accordingly.} \]

24. Compensation Events

24.1 The following issues shall constitute Compensation Events:

(a) The Employer does not give access to a part of the Site by the Site Possession Date stated in the Appendix to Conditions of Contract.

(b) The Employer modifies the List of Other Contractors, etc., in a way that affects the Work of the Contractor under the Contract.

(c) The Project Manager orders a delay or does not issue drawings, specifications or instructions required for execution of the Works on time.

(d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon the Work, which is then found to have no defects.

(e) The Project Manager unreasonably does not approve a subcontract to be let.

(f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to tenderers (including
the Site investigation reports), from information available publicly and from a visual inspection of the Site.

(g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Employer or additional work required for safety or other reasons.

(b) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

(i) The effects on the Contractor of any of the Employer’s risks.

(j) The Project Manager unreasonably delays issuing a Certificate of Completion.

(k) Other compensation events described in the Contract or determined by the Project Manager shall apply.

24.2 If a compensation event would cause additional cost or would prevent the Work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

24.3 As soon as information demonstrating the effect of each compensation event upon the Contractor’s forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor’s forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager’s own forecast. The Project Manager will assume that the Contractor will react competently and promptly to the event.

24.4 The Contractor shall not be entitled to compensation to the extent that the Employer’s interests are adversely affected by the Contractor not having given early warning or not having co-operated with the Project Manager.

24.5 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the Appendix to Conditions of Contract.

24.6 The Contractor shall give written notice to the Project Manager of his intention to make a claim within thirty days after the event giving rise to the claim has first arisen. The claim shall be submitted within thirty days thereafter.
Provided always that should the event giving rise to the claim of continuing effect, the Contractor shall submit an interim claim within the said thirty days and a final claim within thirty days of the end of the event giving rise to the claim.

25. **Price Adjustment**

25.1 The Project Manager shall adjust the Contract Price if taxes, duties and other levies are changed between the date 30 days before the submission of tenders for the Contract and the date of Completion. The adjustment shall be the change in the amount of tax payable by the Contractor.

25.2 The Contract Price shall be deemed to be based on exchange rates current at the date of tender submission in calculating the cost to the Contractor of materials to be specifically imported (by express provisions in the Contract Bills of Quantities or Specifications) for permanent incorporation in the Works. Unless otherwise stated in the Contract, if at any time during the period of the Contract exchange rates shall be varied and this shall affect the cost to the Contractor of such materials, then the Project Manager shall assess the net difference in the cost of such materials. Any amount from time to time so assessed shall be added to or deducted from the Contract Price, as the case may be.

25.3 Unless otherwise stated in the Contract, the Contract Price shall be deemed to have been calculated in the manner set out below and in sub-clauses 25.4 and 25.5 and shall be subject to adjustment in the events specified thereunder;

(i) The prices contained in the Contract Bills of Quantities shall be deemed to be based upon the rates of wages and other emoluments and expenses as determined by the Joint Building Council of Kenya (J.B.C.) and set out in the schedule of basic rates issued 30 days before the date for submission of tenders. A copy of the schedule used by the Contractor in his pricing shall be attached in the Appendix to Conditions of Contract.

(ii) Upon J.B.C. determining that any of the said rates of wages or other emoluments and expenses are increased or decreased, then the Contract Price shall be increased or decreased by the amount assessed by the Project Manager based upon the difference, expressed as a percentage, between the rate set out in the schedule of basic rates issued 30 days before the date for submission of tenders and the rate published by the J.B.C. and applied to the quantum of labour incorporated within the amount of Work remaining to be executed at the date of publication of such increase or decrease.
(iii) No adjustment shall be made in respect of changes in the rates of wages and other emoluments and expenses which occur after the date of Completion except during such other period as may be granted as an extension of time under clause 17.0 of these Conditions.

25.4 The prices contained in the Contract Bills of Quantities shall be deemed to be based upon the basic prices of materials to be permanently incorporated in the Works as determined by the J.B.C. and set out in the schedule of basic rates issued 30 days before the date for submission of tenders. A copy of the schedule used by the Contractor in his pricing shall be attached in the Appendix to Conditions of Contract.

25.5 Upon the J.B.C. determining that any of the said basic prices are increased or decreased then the Contract Price shall be increased or decreased by the amount to be assessed by the Project Manager based upon the difference between the price set out in the schedule of basic rates issued 30 days before the date for submission of tenders and the rate published by the J.B.C. and applied to the quantum of the relevant materials which have not been taken into account in arriving at the amount of any interim certificate under clause 23 of these Conditions issued before the date of publication of such increase or decrease.

25.6 No adjustment shall be made in respect of changes in basic prices of materials which occur after the date for Completion except during such other period as may be granted as an extension of time under clause 17.0 of these Conditions.

25.7 The provisions of sub-clause 25.1 to 25.2 herein shall not apply in respect of any materials included in the schedule of basic rates.

26. Retention

26.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the Appendix to Conditions of Contract until Completion of the whole of the Works. On Completion of the whole of the Works, half the total amount retained shall be repaid to the Contractor and the remaining half when the Defects Liability Period has passed and the Project Manager has certified that all defects notified to the Contractor before the end of this period have been corrected.

27. Liquidated Damages

27.1 The Contractor shall pay liquidated damages to the Employer at the rate stated in the Appendix to Conditions of Contract for each day that the actual Completion Date is later than the Intended Completion Date. The Employer may deduct liquidated damages from payments.
due to the Contractor. Payment of liquidated damages shall not alter the Contractor’s liabilities.

27.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rate specified in Clause 23.30

28. Securities

28.1 The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a reputable bank acceptable to the Employer, and denominated in Kenya Shillings. The Performance Security shall be valid until a date 30 days beyond the date of issue of the Certificate of Completion.

29. Dayworks

29.1 If applicable, the Dayworks rates in the Contractor’s tender shall be used for small additional amounts of Work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.

29.2 All work to be paid for as Dayworks shall be recorded by the Contractor on Forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the Work being done.

29.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

30. Liability and Insurance

30.1 From the Start Date until the Defects Correction Certificate has been issued, the following are the Employer’s risks:

(a) The risk of personal injury, death or loss of or damage to property (excluding the Works, Plant, Materials and Equipment), which are due to;

(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works, or

(ii) negligence, breach of statutory duty or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.
(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in Employer’s design, or due to war or radioactive contamination directly affecting the place where the Works are being executed.

30.2 From the Completion Date until the Defects Correction Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is the Employer’s risk except loss or damage due to;

(a) a defect which existed on or before the Completion Date.

(b) an event occurring before the Completion Date, which was not itself the Employer’s risk

(c) the activities of the Contractor on the Site after the Completion Date.

30.3 From the Start Date until the Defects Correction Certificate has been issued, the risks of personal injury, death and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer’s risk are Contractor’s risks.

The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts stated in the Appendix to Conditions of Contract for the following events;

(a) loss of or damage to the Works, Plant, and Materials;

(b) loss of or damage to Equipment;

(c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract, and

(d) personal injury or death.

30.4 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager’s approval before the Start Date. All such insurance shall provide for compensation required to rectify the loss or damage incurred.

30.5 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance which the Contractor should have provided and recover the premiums from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

30.6 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager. Both parties shall comply with any conditions of insurance policies.
31. **Completion and taking over**

31.1 Upon deciding that the Works are complete, the Contractor shall issue a written request to the Project Manager to issue a Certificate of Completion of the Works. The Employer shall take over the Site and the Works within seven [7] days of the Project Manager’s issuing a Certificate of Completion.

32. **Final Account**

32.1 The Contractor shall issue the Project Manager with a detailed account of the total amount that the Contractor considers payable to him by the Employer under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 30 days of receiving the Contractor’s account if it is correct and complete. If it is not, the Project Manager shall issue within 30 days a schedule that states the scope of the corrections or additions that are necessary. If the final account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a Payment Certificate. The Employer shall pay the Contractor the amount due in the Final Certificate within 60 days.

33. **Termination**

33.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract. These fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) the Contractor stops work for 30 days when no stoppage of work is shown on the current program and the stoppage has not been authorised by the Project Manager;

(b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 30 days;

(c) the Contractor is declared bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 30 days (for Interim Certificate) or 60 days (for Final Certificate) of issue.

(e) the Project Manager gives notice that failure to correct a particular defect is a fundamental breach of Contract and the
Contractor fails to correct it within a reasonable period of time determined by the Project Manager;

(f) the Contractor does not maintain a security, which is required.

33.2 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under Clause 33.1 above, the Project Manager shall decide whether the breach is fundamental or not.

33.3 Notwithstanding the above, the Employer may terminate the Contract for convenience.

33.4 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible. The Project Manager shall immediately thereafter arrange for a meeting for the purpose of taking record of the Works executed and materials, goods, equipment and temporary buildings on Site.

34. Payment Upon Termination

34.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the Work done and materials ordered and delivered to Site up to the date of the issue of the certificate. Additional liquidated damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable by the Contractor.

34.2 If the Contract is terminated for the Employer’s convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the Work done, materials ordered, the reasonable cost of removal of equipment, repatriation of the Contractor’s personnel employed solely on the Works, and the Contractor’s costs of protecting and securing the Works.

34.3 The Employer may employ and pay other persons to carry out and complete the Works and to rectify any defects and may enter upon the Works and use all materials on the Site, plant, equipment and temporary works.

34.4 The Contractor shall, during the execution or after the completion of the Works under this clause remove from the Site as and when required, within such reasonable time as the Project Manager may in writing specify, any temporary buildings, plant, machinery, appliances, goods or materials belonging to or hired by him, and in default the Employer may (without being responsible for any loss or
Remove and sell any such property of the Contractor, holding the proceeds less all costs incurred to the credit of the Contractor. Until after completion of the Works under this clause the Employer shall not be bound by any other provision of this Contract to make any payment to the Contractor, but upon such completion as aforesaid and the verification within a reasonable time of the accounts therefore the Project Manager shall certify the amount of expenses properly incurred by the Employer and, if such amount added to the money paid to the Contractor before such determination exceeds the total amount which would have been payable on due completion in accordance with this Contract the difference shall be a debt payable to the Employer by the Contractor; and if the said amount added to the said money be less than the said total amount, the difference shall be a debt payable by the Employer to the Contractor.

35. Release from Performance

35.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop Work as quickly as possible after receiving this certificate and shall be paid for all Work carried out before receiving it.

36. Corrupt gifts and payments of commission

The Contractor shall not;

(a) Offer or give or agree to give to any person in the service of the Employer any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other Contract for the Employer or for showing or forbearing to show favour or disfavour to any person in relation to this or any other contract for the Employer.

(b) Enter into this or any other contract with the Employer in connection with which commission has been paid or agreed to be paid by him or on his behalf or to his knowledge, unless before the Contract is made particulars of any such commission and of the terms and conditions of any agreement for the payment thereof have been disclosed in writing to the Employer.

Any breach of this Condition by the Contractor or by anyone employed by him or acting on his behalf (whether with or without the knowledge of the Contractor) shall be an offence under the provisions of the Public Procurement Regulations issued under The Exchequer and Audit Act Cap 412 of the Laws of Kenya.
37. **Settlement Of Disputes**

37.1 In case any dispute or difference shall arise between the Employer or the Project Manager on his behalf and the Contractor, either during the progress or after the completion or termination of the Works, such dispute shall be notified in writing by either party to the other with a request to submit it to arbitration and to concur in the appointment of an Arbitrator within thirty days of the notice. The dispute shall be referred to the arbitration and final decision of a person to be agreed between the parties. Failing agreement to concur in the appointment of an Arbitrator, the Arbitrator shall be appointed by the Chairman or Vice Chairman of any of the following professional institutions;

(i) Architectural Association of Kenya

(ii) Institute of Quantity Surveyors of Kenya

(iii) Association of Consulting Engineers of Kenya

(iv) Chartered Institute of Arbitrators (Kenya Branch)

(v) Institution of Engineers of Kenya

On the request of the applying party. The institution written to first by the aggrieved party shall take precedence over all other institutions.

37.2 The arbitration may be on the construction of this Contract or on any matter or thing of whatsoever nature arising thereunder or in connection therewith, including any matter or thing left by this Contract to the discretion of the Project Manager, or the withholding by the Project Manager of any certificate to which the Contractor may claim to be entitled to or the measurement and valuation referred to in clause 23.0 of these conditions, or the rights and liabilities of the parties subsequent to the termination of Contract.

37.3 Provided that no arbitration proceedings shall be commenced on any dispute or difference where notice of a dispute or difference has not been given by the applying party within ninety days of the occurrence or discovery of the matter or issue giving rise to the dispute.

37.4 Notwithstanding the issue of a notice as stated above, the arbitration of such a dispute or difference shall not commence unless an attempt has in the first instance been made by the parties to settle such dispute or difference amicably with or without the assistance of third parties. Proof of such attempt shall be required.

37.5 Notwithstanding anything stated herein the following matters may be referred to arbitration before the practical completion of the Works or
abandonment of the Works or termination of the Contract by either party:

37.5.1 The appointment of a replacement Project Manager upon the said person ceasing to act.

37.5.2 Whether or not the issue of an instruction by the Project Manager is empowered by these Conditions.

37.5.3 Whether or not a certificate has been improperly withheld or is not in accordance with these Conditions.

37.5.4 Any dispute or difference arising in respect of war risks or war damage.

37.6 All other matters shall only be referred to arbitration after the completion or alleged completion of the Works or termination or alleged termination of the Contract, unless the Employer and the Contractor agree otherwise in writing.

37.7 The Arbitrator shall, without prejudice to the generality of his powers, have powers to direct such measurements, computations, tests or valuations as may in his opinion be desirable in order to determine the rights of the parties and assess and award any sums which ought to have been the subject of or included in any certificate.

37.8 The Arbitrator shall, without prejudice to the generality of his powers, have powers to open up, review and revise any certificate, opinion, decision, requirement or notice and to determine all matters in dispute which shall be submitted to him in the same manner as if no such certificate, opinion, decision requirement or notice had been given.

37.9 The award of such Arbitrator shall be final and binding upon the parties.
SECTION IV – APPENDIX TO CONDITIONS OF CONTRACT

THE EMPLOYER IS

Name: KENYA MEDICAL TRAINING COLLEGE
Address: 30195-00100, NAIROBI

Name of Authorised Representative: CHIEF EXECUTIVE OFFICER
Telephone: +254-20-2725711/2/3/4
Facsimile: ____________________________

The Lead Consultant is

Name: Tectonics International Ltd
Address: P.O Box 15311-00509 Nairobi
Telephone: +254-708085733; +254-727836884
Facsimile: ____________________________

The name (and identification number) of the Contract is PROPOSED CONSTRUCTION OF A TUITION BLOCK AT KMTC KILIFI CAMPUS, TENDER NO. KMTC/59/2019-2020

The Works consist of PROPOSED CONSTRUCTION OF A TUITION BLOCK AT KMTC KILIFI CAMPUS

The Start Date shall be AGREED WITH THE LEAD CONSULTANTS

The Intended Completion Date for the whole of the Works shall be _________________(MONTHS)

The following documents also form part of the Contract:
Documents listed in clause 2.1 of the conditions of contract.

The Contractor shall submit a revised program for the Works within 7 days of delivery of the Letter of Acceptance.

The Site Possession Date shall be AGREED WITH THE LEAD CONSULTANTS

The Site is located at KMTC Kilifi, KILIFI Campus.
The Defects Liability period is **6 months after practical completion.**

Other Contractors, utilities etc., to be engaged by the Employer on the Site include those for the execution of:

1. **MECHANICAL INSTALLATIONS**
2. **ELECTRICAL INSTALLATIONS**

The minimum insurance covers shall be:

1. The minimum cover for insurance of the Works and of Plant and Materials in the entire project.
2. The minimum cover for loss or damage to Equipment is KShs 5,000,000
3. The minimum for insurance of other property is KShs 5,000,000
4. The minimum cover for personal injury or death insurance:
   - For the Contractor’s employees is KShs 5,000,000
   - And for other people is KShs 5,000,000

The following events shall also be Compensation Events:

1. **Those listed in the conditions of contract**

The period between Program updates is **30 days.**

The amount to be withheld for late submission of an updated Program is **any certificate due**

The proportion of payments retained is **10 percent.**

The Price Adjustment Clause **shall apply**

The liquidated damages for the whole of the Works is Kshs. ...................... (per week)

The Performance Security shall be **10 percent (10%)** of the contract price.

The Completion Period for the Works is .......................... **MONTHS**

The rate of exchange for calculation of foreign currency payments is **APPLICABLE.**

The schedule of basic rates used in pricing by the Contractor is as attached.

Advance Payment **shall not be granted.**
SECTION V - SPECIFICATIONS

Notes for preparing Specifications

1.0 Specifications must be drafted to present a clear and precise statement of the required standards of materials, and workmanship for tenderers to respond realistically and competitively to the requirements of the Employer and ensure responsiveness of tenders. The Specifications should require that all materials, plant, and other supplies to be permanently incorporated in the Works be new, unused, of the most recent or current models, and incorporating all recent improvements in design and materials unless provided otherwise in the Contract. Where the Contractor is responsible for the design of any part of the permanent Works, the extent of his obligations must be stated.

2.0 Specifications from previous similar projects are useful and may not be necessary to re-write specifications for every Works Contract.

3.0 There are considerable advantages in standardizing General Specifications for repetitive Works in recognized public sectors, such as highways, urban housing, irrigation and water supply. The General Specifications should cover all classes of workmanship, materials and equipment commonly involved in constructions, although not necessarily to be used in a particular works contract. Deletions or addenda should then adapt the General Specifications to the particular Works.

4.0 Care must be taken in drafting Specifications to ensure they are not restrictive. In the Specifications of standards for materials, plant and workmanship, existing Kenya Standards should be used as much as possible, otherwise recognized international standards may also be used.

5.0 The Employer should decide whether technical solutions to specified parts of the Works are to be permitted. Alternatives are appropriate in cases where obvious (and potentially less costly) alternatives are possible to the technical solutions indicated in tender documents for certain elements of the Works, taking into consideration the comparative specialized advantage of potential tenderers.
The Employer should provide a description of the selected parts of the Works with appropriate reference to Drawings, Specifications, Bills of Quantities, and Design or Performance criteria, stating that the alternative solutions shall be at least structurally and functionally equivalent to the basic design parameters and Specifications.

Such alternative solutions shall be accompanied by all information necessary for a complete evaluation by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, proposed construction methodology, and other relevant details. Technical alternatives permitted in this manner shall be considered by the Employer each on its own merits and independently of whether the tenderer has priced the item as described in the Employer’s design included with the tender documents.
SECTION VI - DRAWINGS

Note 1. The actual drawings including Site plans are annexed in a separate booklet.
SECTION VII - BILL OF QUANTITIES

Notes for preparing Bills of Quantities

1.0 The objectives of the Bills of Quantities are;

(a) to provide sufficient information on the quantities of Works to be performed to enable tenders to be prepared efficiently and accurately; and

(b) when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

2.0 The Bills of Quantities should be divided generally into the following sections:

(a) Preliminaries.

The preliminaries should indicate the inclusiveness of the unit prices, and should state the methods of measurement which have been adopted in the preparation of the Bill of Quantities and which are to be used for the measurement of any part of the Works.

The number of preliminary items to be priced by the tenderer should be limited to tangible items such as site office and other temporary works, otherwise items such as security for the Works which are primarily part of the Contractor’s obligations should be included in the Contractor’s rates.

(b) Work Items

(i) The items in the Bills of Quantities should be grouped into sections to distinguish between those parts of the Works which by nature, location, access, timing, or any other special characteristics may give rise to different methods of construction, or phasing of the Works, or considerations of cost. General items common to all parts of the Works may be grouped as a separate section in the Bill of Quantities.
(ii) Quantities should be computed net from the Drawings, unless directed otherwise in the Contract, and no allowance should be made for bulking, shrinkage or waste. Quantities should be rounded up or down where appropriate.

(iii) The following units of measurement and abbreviations are recommended for use.

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<thead>
<tr>
<th>Unit</th>
<th>Abbreviation</th>
<th>Unit</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>cubic meter</td>
<td>m³ or cu m</td>
<td>millimeter</td>
<td>mm</td>
</tr>
<tr>
<td>hectare</td>
<td>ha</td>
<td>month</td>
<td>mon</td>
</tr>
<tr>
<td>hour</td>
<td>h</td>
<td>number</td>
<td>nr</td>
</tr>
<tr>
<td>kilogram</td>
<td>kg</td>
<td>square meter</td>
<td>m² or sq m</td>
</tr>
<tr>
<td>lump sum</td>
<td>sum</td>
<td>square millimeter</td>
<td>mm² or sq mm</td>
</tr>
<tr>
<td>meter</td>
<td>m</td>
<td>week</td>
<td>wk</td>
</tr>
<tr>
<td>metric ton</td>
<td>t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1,000 kg)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

(iv) The commencing surface should be identified in the description of each item for Work involving excavation, boring or drilling, for which the commencing surface is not also the original surface. The excavated surface should be identified in the description of each item for Work involving excavation for which the excavated surface is not also the final surface. The depths of Work should be measured from the commencing surface to the excavated surface, as defined.

c) Daywork Schedule

A Daywork Schedule should be included if the probability of unforeseen work, outside the items included in the Bill of Quantities, is relatively high. To facilitate checking by the Employer of the realism of rates quoted by the tenderers, the Daywork Schedule should normally comprise:

(i) a list of the various classes of labour, and materials for which basic Day work rates or prices are to be inserted by the tenderer, together with a statement of the conditions under which the Contractor will be paid for Work executed on a Day work basis; and

(ii) a percentage to be entered by the tenderer against each basic Day work Subtotal amount for labour, materials and plant representing the Contractor’s profit, overheads, supervision and other charges.
(d) Provisional Quantities and Sums

(i) Provision for quantity contingencies in any particular item or class of Work with a high expectation of quantity overrun should be made by entering specific “Provisional Quantities” or “Provisional Items” in the Bill of Quantities, and not by increasing the quantities for that item or class of Work beyond those of the Work normally expected to be required. To the extent not covered above, a general provision for physical contingencies (quantity overruns) should be made by including a “Provisional Sum” in the Summary of the Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a “Provisional Sum” in the Summary of the Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises.

(ii) Provisional sums to cover specialized works normally carried out by Nominated Sub Contractors should be avoided and instead Bills of Quantities of the specialised Works should be included as a section of the main Bills of Quantities to be priced by the Main Contractor. The Main Contractor should be required to indicate the name(s) of the specialised firms he proposes to engage to carry out the specialized Works as his approved domestic sub-contractors. Only provisional sums to cover specialized Works by statutory authorities should be included in the Bills of Quantities.

(e) Summary

The Summary should contain a tabulation of the separate parts of the Bills of Quantities carried forward, with provisional sums for Daywork, for physical (quantity) contingencies, and for price contingencies (upward price adjustment) where applicable.
SECTION VIII – STANDARD FORM

(i) Form of Invitation for Tenders
(ii) Form of Tender
(iii) Letter of Acceptance
(iv) Form of Agreement
(v) Form of Tender Security
(vi) Performance Bank Guarantee
(vii) Bank Guarantee for Advance Payment
(viii) Qualification Information
(ix) Tender Questionnaire
(x) Confidential Business Questionnaire
(xi) Declaration of Foreign Currency Requirement
(xii) Details of Sub-Contractors
(x) Request for Review Form
FORM OF INVITATION FOR TENDERS

___________________________ [date]
To: ___________________________ [name of Contractor]
___________________________ [address]

Dear Sirs:

Reference: ______________________ [Contract Name]

You have been prequalified to tender for the above project.

We hereby invite you and other prequalified tenderers to submit a tender for the execution and completion of the above Contract.

A complete set of tender documents may be purchased by you from ______
___________________________ [mailing address, cable/telex/facsimile numbers].

Upon payment of a non-refundable fee of Kshs ________________

All tenders must be accompanied by ___________ number of copies of the same and a security in the form and amount specified in the tendering documents, and must be delivered to ______
___________________________ [address and location]

at or before ___________ (time and date). Tenders will be opened immediately thereafter, in the presence of tenderers’ representatives who choose to attend.

Please confirm receipt of this letter immediately in writing by cable/facsimile or telex.

Yours faithfully,

___________________________ Authorised Signature

___________________________ Name and Title
Dear Sir,

1. In accordance with the Conditions of Contract, Specifications, Drawings and Bills of Quantities for the execution of the above named Works, we, the undersigned offer to construct, install and complete such Works and remedy any defects therein for the sum of Kshs. [Amount in figures] Kenya Shillings [Amount in words]

2. We undertake, if our tender is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Project Manager’s notice to commence, and to complete the whole of the Works comprised in the Contract within the time stated in the Appendix to Conditions of Contract.

3. We agree to abide by this tender until [Insert date], and it shall remain binding upon us and may be accepted at any time before that date.

4. Unless and until a formal Agreement is prepared and executed this tender together with your written acceptance thereof, shall constitute a binding Contract between us.

5. We understand that you are not bound to accept the lowest or any tender you may receive.

Dated this __________ day of __________ 20________

Signature ______________ in the capacity of ______________

duly authorized to sign tenders for and on behalf of ______________ [Name of Employer]
of ______________ [Address of Employer]

Witness; Name ______________________

Address ______________________

Signature ______________________

Date ______________________

(MOVED TO PAGE 2 FOR CONVENIENCE)
LETTER OF ACCEPTANCE
[letterhead paper of the Employer]

[(date)]

To:
[name of the Contractor]

[address of the Contractor]

Dear Sir,

This is to notify you that your Tender dated ____________________ for the execution of [name of the Contract and identification number, as given in the Tender documents] for the Contract Price of Kshs. ____________(amount in figures) [Kenya Shillings ____________ (amount in words)] in accordance with the Instructions to Tenderers is hereby accepted.

You are hereby instructed to proceed with the execution of the said Works in accordance with the Contract documents.

Authorized Signature ____________________________________________

Name and Title of Signatory ________________________________________

Attachment: Agreement
FORM OF AGREEMENT

THIS AGREEMENT, made the____________ day of_______20_____,
between____________________of (or whose registered
office is situated at ____________________________ (hereinafter called “the Employer”) of the one part AND
____________________ of (or whose registered
office is situated at ____________________________ (hereinafter called “the Contractor”) of the other part.

WHEREAS THE Employer is desirous that the Contractor executes
_____________________ (hereinafter called “the Works”) located at ____________________________ and the
Employer has accepted the tender submitted by the Contractor for the execution and completion of such Works and the remedying of any defects therein for the
Contract Price of Kshs___________________________ [Amount in figures], Kenya Shillings___________________________ [Amount in words].

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and shall be read and construed as part of this Agreement i.e.

   (i) Letter of Acceptance
   (ii) Form of Tender
   (iii) Conditions of Contract Part I
   (iv) Conditions of Contract Part II and Appendix to Conditions of Contract
   (v) Specifications
   (vi) Drawings
   (vii) Priced Bills of Quantities

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The common Seal of 

Was hereunto affixed in the presence of 

Signed Sealed, and Delivered by the said 

Binding Signature of Employer 

Binding Signature of Contractor 

In the presence of   (i) Name 

Address 

Signature 

(ii) Name 

Address 

Signature
FORM OF TENDER SECURITY

WHEREAS ...........................................(hereinafter called “the Tenderer”) has submitted his tender dated ........................................ for the construction of ...........................................(name of Contract)

KNOW ALL PEOPLE by these presents that WE ............................................ having our registered office at ...........................................(hereinafter called “the Bank”), are bound unto ...........................................(hereinafter called “the Employer”) in the sum of Kshs. ........................................ for which payment well and truly to be made to the said Employer, the Bank binds itself, its successors and assigns by these presents sealed with the Common Seal of the said Bank this ........................................ Day of ...............20............

THE CONDITIONS of this obligation are:

1. If after tender opening the tenderer withdraws his tender during the period of tender validity specified in the instructions to tenderers
   Or

2. If the tenderer, having been notified of the acceptance of his tender by the Employer during the period of tender validity:

   (a) fails or refuses to execute the form of Agreement in accordance with the Instructions to Tenderers, if required; or
   (b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Tenderers;

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him, owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This guarantee will remain in force up to and including thirty (30) days after the period of tender validity, and any demand in respect thereof should reach the Bank not later than the said date.

[signature of the Bank]

[witness] [seal]
To: _________________________________ (Name of Employer) ____________________________ (Date)
_________________________________________ (Address of Employer)

Dear Sir,

WHEREAS _______________________________ (hereinafter called “the Contractor”) has undertaken, in pursuance of Contract No. ___________ dated ___________ to execute _______________ (hereinafter called “the Works”);

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognised bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Kshs. _______________ (amount of Guarantee in figures) Kenya Shillings _______________ (amount of Guarantee in words), and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of Kenya Shillings _______________ (amount of Guarantee in words) as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change, addition or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any change, addition, or modification.

This guarantee shall be valid until the date of issue of the Certificate of Completion.

SIGNATURE AND SEAL OF THE GUARANTOR ____________________________

Name of Bank ______________________________________________

Address ______________________________________________________

Date ____________________________
BANK GUARANTEE FOR ADVANCE PAYMENT

To: [name of Employer] [Date]

Gentlemen,

Ref: [name of Contract]

In accordance with the provisions of the Conditions of Contract of the above-mentioned Contract, We, [name and Address of Contractor] (hereinafter called “the Contractor”) shall deposit with [name of Employer] a bank guarantee to guarantee his proper and faithful performance under the said Contract in an amount of Kshs. [amount of Guarantee in figures] Kenya Shillings [amount of Guarantee in words].

We, [bank or financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligor and not as Surety merely, the payment to [name of Employer] on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding Kshs. [amount of Guarantee in figures] Kenya Shillings [amount of Guarantee in words], such amount to be reduced periodically by the amounts recovered by you from the proceeds of the Contract.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between [name of Employer] and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

No drawing may be made by you under this guarantee until we have received notice in writing from you that an advance payment of the amount listed above has been paid to the Contractor pursuant to the Contract.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until [name of Employer] receives full payment of the same amount from the Contract.

Yours faithfully,

Signature and Seal _____________________________
Name of the Bank or financial institution ______________________
Address _____________________________________________________
Date _________________________________________________________
Witness: Name: ______________________________________________
Address: ____________________________________________________
Signature: ____________________________________________________
Date: _________________________________________________________
QUALIFICATION INFORMATION

1. Individual Tenderers or Individual Members of Joint Ventures

1.1 Constitution or legal status of tenderer (attach copy or Incorporation Certificate);
   Place of registration: ____________________________
   Principal place of business ____________________________
   Power of attorney of signatory of tender ____________________________

1.2 Total annual volume of construction work performed in the last five years

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
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</tr>
</tbody>
</table>

1.3 Work performed as Main Contractor on works of a similar nature and volume over the last five years. Also list details of work under way or committed, including expected completion date.

<table>
<thead>
<tr>
<th>Project name</th>
<th>Name of client and contact person</th>
<th>Type of work performed and year of completion</th>
<th>Value of Contract</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

1.4 Major items of Contractor’s Equipment proposed for carrying out the Works. List all information requested below.

<table>
<thead>
<tr>
<th>Item of Equipment</th>
<th>Description, Make and age (years)</th>
<th>Condition (new, good, poor) and number available</th>
<th>Owned, leased (from whom?), or to be purchased (from whom?)</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

(etc.)
1.5 Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data.

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Years of experience (general)</th>
<th>Years of experience in proposed position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
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1.6 Financial reports for the last five years: balance sheets, profit and loss statements, auditor’s reports, etc. List below and attach copies.

1.7 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List below and attach copies of supportive documents.

1.8 Name, address and telephone, telex and facsimile numbers of banks that may provide reference if contacted by the Employer.

1.9 Statement of compliance with the requirements of Clause 1.2 of the Instructions to Tenderers.

1.10 Proposed program (work method and schedule) for the whole of the Works.
2 Joint Ventures

2.4 The information listed in 1.1 – 1.10 above shall be provided for each partner of the joint venture.

2.5 The information required in 1.11 above shall be provided for the joint venture.

2.6 Attach the power of attorney of the signatory(ies) of the tender authorizing signature of the tender on behalf of the joint venture.

2.7 Attach the Agreement among all partners of the joint venture (and which is legally binding on all partners), which shows that:

a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;

b) one of the partners will be nominated as being in charge, authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture; and

c) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.
TENDER QUESTIONNAIRE

Please fill in block letters.

1. Full names of tenderer

…………………………………………………………………………………………

2. Full address of tenderer to which tender correspondence is to be sent
(unless an agent has been appointed below)

…………………………………………………………………………………………

3. Telephone number (s) of tenderer

…………………………………………………………………………………………

4. Telex address of tenderer

…………………………………………………………………………………………

5. Name of tenderer’s representative to be contacted on matters of the tender
during the tender period

…………………………………………………………………………………………

6. Details of tenderer’s nominated agent (if any) to receive tender notices. This
is essential if the tenderer does not have his registered address in Kenya
(name, address, telephone, telex)

…………………………………………………………………………………………

…………………………………………………………………………………………

Signature of Tenderer

Make copy and deliver to:___________________ (Name of Employer)
CONFIDENTIAL BUSINESS QUESTIONNAIRE

You are requested to give the particulars indicated in Part 1 and either Part 2 (a), 2 (b) or 2 (c) and 2 (d) whichever applies to your type of business.

You are advised that it is a serious offence to give false information on this Form.

Part 1 – General

Business Name .................................................................

Location of business premises; Country/Town......................

Plot No........................................ Street/Road ..................

Postal Address.......................................................... Tel No..........................

Nature of Business................................................................

Current Trade Licence No.............. Expiring date...........

Maximum value of business which you can handle at any time: K. pound................

Name of your bankers........................................................

Branch.............................................................................

Part 2 (a) – Sole Proprietor

Your name in full........................... Age......................

Nationality................................. Country of Origin ........

*Citizenship details ...........................................................

Part 2 (b) – Partnership

Give details of partners as follows:

<table>
<thead>
<tr>
<th>Name in full</th>
<th>Nationality</th>
<th>Citizenship Details</th>
<th>Shares</th>
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<td>3..........................................................</td>
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</table>
**Part 2(c) - Registered Company:**

Private or public.................................................................................................

State the nominal and issued capital of the Company-

Nominal Kshs.................................................................................................

Issued Kshs.................................................................................................

Give details of all directors as follows:


1. ...........................................................................................................

2. ...........................................................................................................

3. ...........................................................................................................

4. ...........................................................................................................

**Part 2(d) - Interest in the Firm:**

Is there any person / persons in ............... ...........(Name of Employer) who has interest in this firm? Yes/No... ......................(Delete as necessary)

I certify that the information given above is correct.

............................................. ............................................. ........................

(Title) (Signature) (Date)

- Attach proof of citizenship
STATEMENT OF FOREIGN CURRENCY REQUIREMENTS

(See Clause 23] of the Conditions of Contract)

In the event of our Tender for the execution of __________________________ (name of Contract) being accepted, we would require in accordance with Clause 21 of the Conditions of Contract, which is attached hereto, the following percentage:

(Figures)………………………… (Words)…………………………………

of the Contract Sum, (Less Fluctuations) to be paid in foreign currency.

Currency in which foreign exchange element is required:

...........................................................................................................

Date: The .......... Day of ............. 20.......... 

Enter 0% (zero percent) if no payment will be made in foreign currency.

Maximum foreign currency requirement shall be ___________(percent) of the Contract Sum, less Fluctuations.

(Signature of Tenderer)
If the Tenderer wishes to sublet any portions of the Works under any heading, he must give below details of the sub-contractors he intends to employ for each portion.

Failure to comply with this requirement may invalidate the tender.

(1) Portion of Works to be sublet: ........................................

(i) Full name of Sub-contractor and address of head office: ........................................

..........................................................................................................................

(ii) Sub-contractor’s experience of similar works carried out in the last 3 years with Contract value: ........................................

..........................................................................................................................

..........................................................................................................................

(2) Portion of Works to be sublet: ........................................

(i) Full name of sub-contractor and address of head office: ........................................

..........................................................................................................................

..........................................................................................................................

(ii) Sub-contractor’s experience of similar works carried out in the last 3 years with contract value: ........................................

..........................................................................................................................

..........................................................................................................................

[Signature of Tenderer] ................................................ Date ........................................

66
LETTER OF NOTIFICATION OF AWARD

To: __________________________

__________________________

__________________________

RE: Tender No. ________________

Tender Name_______________

This is to notify that the contract/s stated below under the above mentioned tender have been awarded to you.

1. Please acknowledge receipt of this letter of notification signifying your acceptance.

2. The contract/contracts shall be signed by the parties within 30 days of the date of this letter but not earlier than 14 days from the date of the letter.

3. You may contact the officer(s) whose particulars appear below on the subject matter of this letter of notification of award.

(FULL PARTICULARS) ________________________________

SIGNED FOR ACCOUNTING OFFICER
VOLUME II

BILLS OF QUANTITIES for
MAIN CONTRACT WORKS  Only
(Services Bills of Quantities shall be separate)
Disclaimer:

1. These Bills of Quantities are prepared using the attached Architectural Drawings Only.

2. The Quantity Surveyor has assumed a general flat site for each facility, which may vary depending on different sites.

3. There was no Structural/Civil Engineering input in the design.
**PROPOSED TUITION BLOCK TYPE 02**

**FOR**

**KENYA MEDICAL TRAINING COLLEGE**

**INDEX TO BILLS OF QUANTITIES**

**VOLUME II**

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<td>(MAIN CONTRACT WORKS ONLY)</td>
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VOLUME II
SECTION NO. 1

PRELIMINARIES
## SECTION NO 1

### PRELIMINARIES
### PRELIMINARY PARTICULARS

### PARTIES TO THE CONTRACT

**A** THE EMPLOYER. The "Employer" is Kenya Medical Training College, Nairobi, Kenya.

**B** DESCRIPTION OF SITE

The site of the works is situated at the various campuses of the Kenya Medical Training College countrywide.

The Contractor is recommended to visit the site and he shall be deemed to have acquainted himself therewith as to the nature and position, means of access etc., and no claim in this connection will be allowed for travelling or other expenses which may be incurred by the Contractor in visiting the site or preparing the tender for the Works.

The Contractor must obtain the approval of the Architect regarding the use of any materials found on the site or fill obtained from demolition work.

### DESCRIPTION OF WORKS AND SCOPE OF CONTRACT

**D** The works to be executed under this contract comprises the proposed construction of Tuition Block building and associated External Works.

Mechanical Works and Electrical Works will be executed by approved sub-contractors.

The tenderer is required to submit any proposed sub-contractors names together with the tender.

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### Carried to Collection

**M&A**

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**-1/1/1-* 17/06/2020**
Item No | Quantity | Rate | Amount Shs
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**FORM OF CONTRACT**

A The Contractor will be required to enter into a contract, which conditions are included in the Standard Tender Document for Procurement of Works (Building & Associated Civil Engineering Works) issued by the Public Procurement Oversight Authority 2007.

**APPENDIX TO CONDITIONS OF CONTRACT**

B The Appendix to the Conditions of Contract is included in the Standard Tender Document for Procurement of Works (Building & Associated Civil Engineering Works) issued by the Public Procurement Oversight Authority 2007.

**GENERAL MATTERS**

D **SUFFICIENCY OF TENDER**

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the works and of the rates and prices used in arriving at the lump sum price(s) stated in the priced Bills of Quantities which rates and prices shall cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the works.

**DEFINITIONS AND ABBREVIATIONS**

Abbreviations used in these Bills of Quantities shall be interpreted as follows:

- **"Approved"** shall mean approved by the Architect or the Engineers under the delegated authority of the Architect
- **"as directed"** shall mean as directed by the Architect
- **"Kg"** shall mean Kilogrammes
- **"No."** shall mean Number
- **"L.M"** shall mean Linear Metres

Section No. 1
PRELIMINARIES
Element No. 1
PRELIMINARIES
170

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17/06/2020
PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

KSHS
### Proposed Tuition Block Type 02
#### For Kenya Medical Training College

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<td>&quot;S.M&quot;</td>
<td>shall mean Square Metres</td>
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<tr>
<td>&quot;C.M&quot;</td>
<td>shall mean Cubic metres</td>
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<tr>
<td>&quot;Ditto&quot;</td>
<td>shall mean the whole of the preceding description except as qualified in the section in which it occurs. Where it occurs in brackets it shall mean the whole of the preceding description which is contained within the approximate brackets.</td>
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<td>(M.S)</td>
<td>shall mean Measured separately</td>
<td>Item</td>
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<tr>
<td>&quot;VAT&quot;</td>
<td>shall mean Value Added Tax</td>
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#### A Site Boundaries and Levels

Before commencing work the Contractor must arrange for and agree with the Consultants the existing site boundaries and levels and similarly establish and agree a bench mark.

#### B Setting Out

The Contractor shall set out the Works in accordance with the dimensions and levels shown on the drawings and shall be responsible for the correctness of all dimensions and levels so set out by him and will be required to amend all errors arising from inaccurate setting out at his own cost and expense. In the event of any error or discrepancy in the dimensions or levels marked on the drawings being discovered, such errors or discrepancies must be reported by the Contractor to the Architect for his immediate attention.

No work shall be commenced by the Contractor until he has received written instructions from the Architect to adjust such discrepancies which may be proved. Upon receipt of such instruction the Contractor shall thereupon be responsible for adjustments necessary to comply with such instruction, and no claim for extra expense or relief from the provisions or clauses 21.0 of the Conditions of Contract based on any discrepancy or error in the dimensions or levels shown on the drawings may be made thereafter.

Before any work is commenced by sub-contractors or specialist firms, dimensions must be checked on the site and/or buildings and agreed with the Contractor, irrespective of the comparable dimensions shown on the drawings. The Contractor shall be responsible for the accuracy of such dimensions.

### Carried to Collection

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-1/1/4-  17/06/2020
Proposed Tuition Block Type 02
For Kenya Medical Training College

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### A: Samples
The Contractor shall furnish at the earliest possible opportunity before works commences and at his own cost, samples of materials or workmanship that may be called for by the Architect for his approval or rejection and any further samples in the case of rejection until such samples are approved by the Architect and such samples when approved shall be the minimum standard for the works to which they apply.

### B: Shop Drawings
The Contractor shall prepare for scrutiny and issue to the Architect, copies of detailed shop drawings of all specialist works. Following the Architect's checking of these shop drawings the Contractor shall immediately amend them as necessary and when approved, promptly issue to the Architect four copies for general use.

The scrutiny of shop drawings by the Architect shall be for general conformity, including conformity with the work of others and to co-ordinate the contract work in space. Such approval shall not imply any further indication of correctness.

### C: Existing Property
The Contractor shall take every precaution to avoid damage to all existing property including beacons, landscaping, roads, cables, drains, other services etc; and he will be held responsible for all damage thereto, arising from the execution of this Contract, and he shall make good all such damage when directed at his own expenses.

### D: Existing Services
Prior to commencement of any work the Contractor is to ascertain from the relevant authorities the exact position, depth and level of all existing electric cables, water pipes or other services in the area and he shall make whatever provisions may be required by the authorities concerned for the support and protection of such services. Any damage or disturbance caused to any service shall be reported immediately to the Architect and the relevant authority and shall be made good to their satisfaction at the Contractor's expense.
A MATERIALS, TOOLS, PLANT AND SCAFFOLDING

All materials and workmanship used in the execution of the works shall be of the best quality and description unless otherwise described. Any materials for the works condemned by the Architect shall immediately be removed from the site at the Contractor's expense.

No timber used for scaffolding, formwork or similar purpose shall be used afterwards in the permanent work.

All such plant, tools and scaffolding shall comply with all regulations whether general or local in force throughout the period of the Contract and shall be altered or adapted during the Contract as may be necessary to comply with any amendments in or additions to such regulations.

B LOCAL REGULATIONS AND BYE LAWS

The Contractor is to comply with all local regulations and by-laws of the Local Authority including serving of notices and paying of fees.

C SUPERVISION

The said Works shall be executed under the direction and to the entire satisfaction of the Architect and Engineer's, who shall have the Architect's specifically delegated authority, and who shall at all times have access to the works and to the yards and workshops of the Contractor or other places where work is being prepared for the building works.

D TRANSPORT TO AND FROM THE SITE

The Contractor shall include in his prices for the transport of materials, workmen, etc., to and from the site of the proposed Works, at such hours and by such routes as are permitted by the authorities.

E ACCOMMODATION ON SITE

No accommodation on site will be permitted for the Contractors staff or work people including those of sub-contractors, unless agreed to by the Consultants.
## Item No

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<tr>
<td>A</td>
<td><strong>FAIR WAGES</strong>&lt;br&gt;The Contractor shall pay rates of wages and observe hours and conditions of labour not less favourable than the minimum rates of remuneration and minimum conditions of employment applicable in the district in which the work is carried out. The relevant notice must be posted up and kept posted upon the site where it can conveniently be read by the employees concerned.&lt;br&gt;The Contractor is to comply with the Regulation of Wages and Conditions of Employment Act, Building and Construction Industry Wages Council and is to be responsible for compliance by sub-contractors employed in the execution of the Contract. If required he is to notify the Project Manager may determine.&lt;br&gt;Should a claim be made to the Architect alleging the Contractor's default in payment of Fair Wages of any workman employed on the Contract and if proof thereof satisfactory to the Architect is furnished by the Labour Department, the Architect may, falling payment by the contractor, pay the claim out of any monies due or which may become due to the contractor under this contract.&lt;br&gt;The contractor is to furnish to the Architect, if called upon to do so, such particulars of the rates of wages, hours and conditions of labour referred above, as the Architect may direct.</td>
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<td>B</td>
<td><strong>SECURITY OF WORKS AND FENCING</strong>&lt;br&gt;The Contractor shall be entirely responsible for the security of all the works, stores, materials, plant, personnel, etc., both his own and sub-contractors and shall provide all necessary watching, lighting and other precautions as necessary to ensure the security and the protection of the public.</td>
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<td>C</td>
<td><strong>PUBLIC AND PRIVATE ROADS, PAVEMENT, ETC.</strong>&lt;br&gt;The Contractor will be required to make good at his own expense any damage he may cause to the present approach road surfaces during the period of the Works.</td>
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<td><strong>POLICE REGULATIONS</strong>&lt;br&gt;The Contractor is to allow for complying with all instructions and regulations of the Police Authorities.</td>
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### Carried to Collection

Section No. 1<br>PRELIMINARIES<br>Element No. 1<br>PRELIMINARIES<br>170<br>M&A
### Item A
**AREA TO BE OCCUPIED BY CONTRACTOR**

The area of the site which may be occupied by the contractor for use as storage and for the purpose of erecting workshops, etc., shall be defined on the site by the Architect.

### Item B
**PROGRAMME OF WORKS**

A programme for the works is to be submitted in accordance with clause 18.0 the Conditions of Contract. The programme is to be a computerised critical path programme schedule which the Contractor will prepare, develop and maintain during the course of the Contract. The software programme is to be a specialised critical path programme to the approval of the Architect. The schedule shall include construction and procurement activities as well as other time related factors. The Contractor is to prepare the time related factors. The Contractor is to prepare the time schedule showing the time and order in which he proposes to carry out the works within the total construction time stated in the contract. The schedule shall show in detail the construction time and order in which each section of the work is to be carried out and be sub-divided into elements, trades and tasks. The schedule shall indicate the times when information is required from the Consultants especially in relation to the ordering of imported materials.

The time schedule is to be agreed with the Architect.

At the end of each month the Contractor is to incorporate actual start and finish dates into the time schedule and produce a construction schedule update and analysis for the Architect. The analysis is to show actual start and finish dates, identify out of sequence work, critical activities and any constraints which have or may effect the progress of the works.

During the execution of the works the Contractor will incorporate any changes to the time schedule only if approved ‘in writing’ by the Architect arising for whatsoever reason, and produce a revised schedule.

The Contractor will provide the Architect with a soft copy of the time schedule including monthly updates and analyses together with four printed copies of the relevant data.

### Item C
**SITE PHOTOGRAPHS**

The Contractor shall allow for taking digital site photographs on a weekly basis to the satisfaction of the Consultants. Copies of the photographs shall be provided to the Employer and Consultants as required, and a weekly record shall be placed on a board in the Site Office.
A WORKING HOURS AND OVERTIME

The working hours shall be 8.00am to 5.00pm Monday to Saturday.

No work shall be carried out on Sundays, gazetted public holidays or after the above working hours unless authorized by the Architect.

The Contractor shall be responsible for any extra costs for overtime working he considers will be necessary in order to complete the work within the contract period or time for completion apart from overtime working which may be authorized by the Architect.

If overtime is worked in accordance with a written instruction issued by the Architect, the Contractor will be reimbursed in respect of such overtime to the extent only of the additional nett cost of unproductive time payable over and above the basic hourly rates as laid down by the Regulation of Wages and Conditions of Employment Act, Building and Construction Industry Wages Council and excluding any bonuses, profits and overheads.

B WATER

The Contractor shall provide at his own risk and cost all water for use in connection with the Works including the work of sub-contractors; make arrangements with the Local Authority for the installation of a separate meter for all water used by him throughout the Contract and pay all costs and fees in connection therewith. The Contractor may however connect (if he so wishes) into the existing water supply for water for use in connection with the works including the work of specialists and sub-contractors: but he shall make arrangements with the Employer for the installation of a separate metre for all water used by him and the Sub-Contractors throughout the contract and pay all costs and fees in connection therewith at a rate to be agreed with the Employer in advance. The Contractor shall not use existing water services unless the said agreement with the Employer has been effected in writing. He shall also provide temporary storage tanks and tubing, etc., as he may consider necessary and clear away at completion. All tanks for permanent retention/incorporation shall not be used for this item.

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

Carried to Collection

KSHS
## A LIGHTING AND POWER

The Contractor shall provide at his own risk and cost all artificial lighting and power for use on the works, including all sub-contractors and specialists requirements and including all temporary connections, wiring, fittings etc., and clearing away on completion. The Contractor shall pay all fees and obtain all permits in connection therewith.

All such temporary works shall be cleared away on completion.

## B CONCRETE TESTS

NOTE: The Contractor must allow in his rate all costs in connection with the making of the cubes, curing, transport, crushing by Local Authority and obtaining the test certificate.

Set of four 150 x 150 x 150 mm concrete test cubes 800 sets (Provisional) @ Shs .................... each * Contractor to insert rate and extend

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PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

KSHS

17/06/2020
TEMPORARY WORKS

A ACCESS TO SITE AND TEMPORARY ROADS

Means of access to the site shall be agreed with the Architect prior to commencement of the work and the Contractor must allow for building any temporary access roads for the transport of materials, plant and workmen as may be required for the complete execution of the works including the provision of temporary culverts, crossings, bridges or any other means or gaining access.

Upon the completion of the Works the Contractor shall remove such temporary roads, temporary culverts, bridges etc., and make good and reinstate all works and services disturbed to the satisfaction of the Architect.

B TEMPORARY BUILDINGS AND SERVICES

The Contractor shall provide sheds for storage by the Employer for all Client supply goods and materials.

The Contractor shall provide site office, mess rooms and all other buildings required by the contractor for his own use and the use of Sub-contractors.

A Site Office shall be provided for holding of Site Meetings. This shall be fully equipped with a table and chairs of sufficient size and number.

A separate 25m² office, equipped with telephone, e-mail facilities and all furniture, shall be provided for the Consultants use.

A separate 50m² office, unfurnished, shall be provided for the Clients use.

Notice boards and drawers shall be provided for drawings, photographs, notices, programme, etc.

Artificial lighting and cleaning shall be provided.

The Contractor shall allow for provision of non-alcoholic refreshments during the site meetings.

Consumption of alcoholic drinks and substances is not permitted on site.

The entire site is a non-smoking area.

The Contractor shall keep on the site and maintain in good condition one dumpy or quickset level, metric levelling staff, one 30 metre steel tape for the use of the Consultants.

Carried to Collection

Section No. 1
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KSHS

17/06/2020
Upon completion all temporary buildings are to be removed and cleared away.

### Item A
**TELEPHONE**

The Contractor shall pay for a mobile telephone on the site, and shall pay all costs and charges in connection therewith.

### Item B
**SANITATION OF THE WORKS**

The sanitation of the Works shall be provided, maintained and removed on completion by the Contractor to the satisfaction of the Architect and Local Authorities.

The latrines shall be enclosed with framing and corrugated sheet steel roofs, sides and partitions with concrete floors, steel trowelled smooth to falls to facilitate washing. Their location shall be agreed with the Architect and the Works shall not be commenced before the sanitary accommodation has been approved by the above-mentioned Authorities.

The Contractor will be required to pay all conservancy charges and shall ensure clean daily maintenance and disinfecting of the latrines, and not less than once per week, the whole area shall be sprayed with disinfectant and insecticide and on completion of the Works the latrines and any temporary drains shall be removed and all works and surfaces disturbed made good and the whole area disinfected and left clean and free from pollution to the satisfaction of the Architect and Local Authorities.

### Item C
**NOTICE BOARD**

The Contractor shall provide and erect where directed and maintain during the whole period of building operations and remove at completion, one approved temporary notice board to the Architect’s standard design and giving a brief description of the Works and showing the names of the Employer, Project Manager, Architects, Quantity Surveyor, Consultant Engineers and Contractor with sufficient space to append the names of Nominated Sub-Contractors and Suppliers when known. The lettering concerning the Architect, Quantity Surveyor and Engineer is to be not more than 50 mm high.

## Carried to Collection

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<th>Description</th>
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### Item No | Quantity | Rate | Amount
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A | The Contractor shall provide individual plot number sign boards measuring not more than 300 x 300 mm fixed onto posts for marking of plots | No | 
B | **HOARDINGS**

The Contractor shall provide hoardings to the boundaries and other areas of the site.

Hoardings around and within site shall be as stated herein before to contractors design approved by the Architect. The locations shall be as approved by the Architect before erection.

C | **PRIME COSTSUMS AND RATES**

i) The words "Prime Cost" (or the initials "PC") wherever appearing in the Contract Documents shall mean net cost exclusive of any trade, cash or other discount whatsoever but inclusive of the cost of packing. Such cost shall be the sums due to the Sub-Contractor or Supplier after adjustment where applicable in respect of measurements or rates.

ii) Any increases or decreases in these Prime Cost Sums and Rates resulting from the adjustments and properly paid by the Contractor shall be added to or deducted from the Contract Sum in the final account. In substantiation the Contractor will be required to produce to the Quantity Surveyor all quotations, invoices and receipted accounts as shall be necessary to show the details of the sums actually paid.

iii) Prime Cost Rates shall be deemed to be exclusive of VAT, delivery to site and fixing. The Contractor shall allow in the overall unit rate or in the VAT element of the Main Summary for these items.

iv) Any sum added by the Contractor in these Bills of Quantities in respect of profit upon any Prime Cost will be deducted at the final settlement of accounts and a sum will be added the amount of which will bear the same proportion to the sum added as the net amount properly expended bears to the original PC sum.

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**M&A**

Carried to Collection

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Section No. 1
PRELIMINARIES
Element No. 1
PRELIMINARIES
170
PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

KSHS
**A NOMINATED SUB-CONTRACTORS**

The Contractor shall accept responsibility for providing the following services for Nominated Sub-Contractors:

i) **GENERAL ATTENDANCE.** The following services are described as “allow for general attendance”:

   - (a) Use, for the purpose of the Sub-Contract Works of any scaffolding belonging to or provided by the Contractor while it remains so erected upon the site, provided that no warranty or other liability on the part of the Contractor or of his other sub-contractors shall be created or implied in regard to the fitness, condition or suitability of the said scaffolding;

   - (b) Provision of water, lighting, watching and attendance for the purpose of the Sub-Contract Works;

   - (c) Use of sanitary accommodation, messrooms and welfare facilities;

   - (d) Provision of space for erection of offices or stores or space for storage of plant and materials;

   - (e) Clearing away rubbish produced by them.

ii) **SPECIAL ATTENDANCE.** The following services are stated under a separate item and where described under the following headings shall mean:

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Section No. 1
PRELIMINARIES
Element No. 1
PRELIMINARIES
170
M&A
PROPOSED TUITION BLOCK TYPE 02  
FOR KENYA MEDICAL TRAINING COLLEGE

**Item No** | **Quantity** | **Rate** | **Amount**  
--- | --- | --- | ---
A | | |  
NOMINATED SUB-CONTRACTORS  
(a) "Taking delivery" shall mean the provision of unskilled labour necessary to attend upon the sub-contractor's workmen for the purpose of unloading plant and materials when received upon the site and placing in position within the Sub-Contractor's storage space or store;
(b) "Hoisting" shall mean the provision of unskilled labour and the use of any Contractor's standing plant for the purpose of assisting the Sub-Contractor's workmen in hoisting the Sub-Contractor's plant and materials to the various levels but not placing in its final position;
(c) "Providing Power" shall mean the provision of power during the course of the Works and during the period of maintenance  
B | | |  
NOMINATED SUPPLIERS  
The Contractor shall take delivery anywhere in Nairobi of all materials or goods supplied by the Nominated Suppliers and shall sign a receipt as having received them in good order and condition. He shall offload, transport to site, unload, hoist, provide safe storage and thereafter be responsible for any loss or damage or replacement of any such lost or damaged articles at his own expense and shall return empty cases if so required.
Provision is made herein following each appropriate P.C. Sum for the cost of the foregoing services against items reading "Take Delivery and Fix Only".  
C | | |  
PROTECTION OF WORK  
The Contractor shall cover up and protect all finished work liable to damage including provision of temporary roof, gutters, drains etc, until the completion of the Works.  
D | | |  
STANDARDS LEVY  
The Contractor's attention is drawn to Legal Notice No 267 of 1990, which requires payment by the Contractor of a Standard Levy to the Kenya Bureau of Standards. The Contractor shall allow in the Preliminaries of this Contract for all costs arising or resulting therefrom.  
--- M&A Carried to Collection  
Section No. 1  
PRELIMINARIES  
Element No. 1  
PRELIMINARIES  
170  
-1/1/15-  
17/06/2020
PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

KSHS
## Proposed Tuition Block Type 02
### For Kenya Medical Training College

### Rate

#### Item No

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### Section No. 1

**Element No. 1**

**PRELIMINARIES**

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<th>PRELIMINARIES</th>
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**170 M&A**
GENERAL SPECIFICATIONS

ARCHITECTURAL SPECIFICATIONS

Part 1 : General
Part 2 : Demolitions and alterations
Part 3 : Site clearance and general excavation
Part 4 : Walling
Part 5 : Roofing and rainwater disposal
Part 6 : Carpentry and joinery
Part 7 : Metalwork
Part 8 : Aluminium windows and shop fronts
Part 9 : Finishings
Part 10 : Glazing
Part 11 : Painting and decorating
Part 12 : Landscaping

STRUCTURAL AND CIVIL ENGINEERING SPECIFICATIONS

Part 13 : Excavations and earthworks
Part 14 : Concrete
Part 15 : Fencing
Part 16 : Pipelines, sewers and drains
Part 17 : Roads (subsurfacing)
Part 18 : Roads (surfacing)
Part 19 : Painting
Part 20 : Structural steel
Part 21 : Masonry and blockwork
Part 22 : Materials
Part 23 : Testing of materials and workmanship

GENERAL MECHANICAL AND ELECTRICAL ENGINEERING SPECIFICATIONS

Part 24 : General specifications for plumbing and drainage services
Part 25 : General specifications for Electrical Installations
PART 1 GENERAL

1.1 Materials Generally

All materials used on the works 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 and all materials which are not approved or which are damaged, contaminated or have deteriorated in any way or do not comply in any way with the requirements of this specification shall be rejected and shall be immediately removed from the site at the Contractor’s expense.

1.2 Materials for which there is a British Standards Specification

All materials used in the works for which a British Standards Specification has been published shall conform with the latest edition thereof in every way. The Architect reserves the right to demand that the Contractor shall obtain at his own expense a certificate in respect of any material to state that it is in accordance with the British Standard Specification.

1.3 Alternatives to proprietary brands

Where materials are specified by their proprietary names or where fittings are specified by catalogue numbers, or descriptions, the Contractor may offer materials or fittings of alternative manufacture which are of equal quality. Such alternatives must be approved before being used in the works and the Contractor shall allow for this, but prior to tendering he may submit to the Architect for approval the names of any suppliers or manufacturers whose products he intends to use, together with catalogue numbers and descriptions and/or samples but the decision of the Architect will be final.

1.4 Samples

The Contractor shall furnish for approval, with reasonable promptness all samples of materials and workmanship required by the Architect. The Architect shall check and approve such samples for conformance with the design concept of the Works and for compliance with the information given in the Contract Documents. The work shall be in accordance with approved samples-

a) All material samples shall be delivered to the Architect’s Office with all charges in connection therewith paid by the Contractor.

b) Duplicate final approved samples, in addition to any required for the Contractor’s use, shall be furnished to the Architect, one for office use and one for the site.

c) Samples shall be furnished so as not to delay fabrication, allowing the Architect reasonable time for consideration of the sample submitted.

d) Each sample shall be properly labelled with the name and quality of the material, manufacturer’s name, name of project, the Contractor’s name and the date of submission and the specification number to which the sample refers.

1.5 Co-ordination with Other Trades

Close co-ordination with electrical and plumbing sub-contractors must be maintained by the Contractor from the commencement of the works to avoid chases being cut in hollow block or 100mm solid block work or across any fair faced work or finished plasterwork. If necessary, conduits should be run down the jambs of the door openings behind the door frame and taken to the switch position through a horizontal joint in the masonry.

1.6 Measuring and Testing Equipment

The Contractor shall provide the following equipment for carrying out measuring and control tests on the site and maintain in full working order:

a) Straight edges 2 metres and 4 metres long for testing the accuracy of the finished concrete.

b) A glass graduated cylinder for use in the silt test of organic impurities in the sand.

c) Slump test apparatus.

d) 150 mm steel cube moulds with base plates and tamping rod to BS 1881.

e) Two 30 metre steel tapes.

f) One dumpy or quickset level and staff.

g) Micrometer.

h) Moisture meter for testing water content in timber.
PART 2

DEMOLITIONS AND ALTERATIONS

2.1 Demolition

Demolitions, taking out and cutting away shall be carefully performed and every precaution shall be taken to ensure the safety of the works. If damage should occur in the carrying out of the demolitions or alterations the contractor shall reinstate and make good the same at his own expense.

2.2 Protection

Supply, erect and maintain during the cutting of openings etc., all necessary protection to the existing premises against damage by weather or other causes.

2.3 Laying the dust

Allow for laying the dust as far as possible during the alteration by watering with a hose or other means.

2.4 Making good

All making good of blockwork, building up of openings etc., shall be in solid blockwork unless otherwise described, in cement mortar (1:4) properly cut, toothed and bonded and pinned up to existing work and pointed where necessary.

2.5 Credit for Materials

Unless otherwise specified materials arising from the demolitions and alterations will become the property of the Contractor. If the Contractor wishes to allow a credit for any such materials the appropriate allowance should be included in the ‘credit’ column of the Bills of Quantities.

In the event that the Employer wishes to take possession of any such materials the Contractor will only be entitled to receive compensation to the amount of credit indicated.

2.6 Definitions of Terms

The following definitions explain and simplify the terms indicated in the description of the works.

Removal shall include:

dismantling/pulling down/taking down/taking out/taking up/stripping etc., at the site of the works getting from the site of the works to the outside of building by whatever means is necessary and disposal.

Disposal shall include:

handling on site to store or to pick up point for loading

loading into skips or lorries

transporting away from site to yard, store or tip

payment of all tip charges.

Making out shall include:

infilling to voids, openings, gaps and the like and matching materials and construction to existing.

Making good shall include:

work as last described consequent on the carrying out of other work.

Form opening in brickwork or blockwork shall include:

shoring up and needling as required

cutting the opening

designing, providing and inserting required beam or lintol and providing any calculations if required and obtaining building regulation approval

providing and inserting cavity gutters and the like

forming new arches and the like in facework to match existing

quoining up jambs

sealing cavity of hollow walls, at jambs and cill and providing and inserting damp proof course

making good facework and features to match existing

forming new external sub-cills or sub-thresholds to match existing

making good the plasterwork or other applied finishes including making out into reveals and providing metal angle beads to arrises where required

removing debris.

Block in/Blank off/Fill in opening in brick

SPECIFICATIONS

SPECIFICATIONS DEMOLITIONS & ALTERATIONS

work or block work shall include:

carefully cutting out any flooring in opening and levelling and preparing for raising new work

cutting toothings for bonding in new work

filling the opening with brickwork or blockwork to match existing

making out facework including cutting out arches, cills or ornamentation around the opening and continuing any general facework pattern

wedging and pinning to existing soffit

providing and inserting matching damp proof course

making out any plasterwork including continuing any existing patterns or labours and making good between new and old work so that after decoration or weathering the original opening cannot be discerned remove debris.

Remove partition shall include:

shoring up if required

sizing, providing and inserting required timber beam if the partition is loadbearing

taking off skirtings, picture rails and the like

stripping off lath plaster or other finished and insulation quilts

taking out doors, borrowed lights, hatches and the like, frames, linings and architraves and the like within any area of partitioning to be removed

dismantling and taking down studding or framed work

making good plasterwork or other wall and ceiling finishes including cornices and other enrichments

making good or making out floor boarding and any applied finishes

taking out timber skirtings, picture rails and the like

removing debris.
Repair roof covering shall include:
The term repair as applied to a tiled or slatted roof includes any or all of the following operations as are necessary:
- renew broken or missing tiles/slates to match existing including nailing with composition nails or securing with copper tinges
- re-wedge and repoint flashings and making out with new as required
- re-make tile/slate verges or eaves including any bedding and pointing
- renew defective or missing ridge or hip tiles
- remove debris.

Renew roof covering shall include:
The term renew roof covering as applied to a tiled or slatted roof includes:
- lift and afterwards refix flashings, soakers, ridge, hip and valley coverings etc
- strip existing roofing and battens, sort and set aside sound tiles/slates
- renew battens and re-lay existing tiles/slates together with new tiles/slates as required all to match existing including sarking felt underlay whether previously provided or not, and including any special tiles/slates to eaves, verges, ridges and valleys
- re-wedge and repoint flashings
- remove debris.

The term renew roof covering as applied to a sheet metal, felt or asphalt roof includes:
- strip existing roofing
- renovate sub-base as required
- lift and afterwards refix flashings
- renew roof covering to match existing
- re-wedge and repoint flashings
- remove debris.

Renew flashings and the like shall include:
The term renew flashings and the like as applied to pitched or flat roofs any or all of the following as may be applicable:
- strip existing flashings, soakers, gutters, ridge and hip coverings
- renew all work previously removed in material or similar quality and substance
- re-wedge and repoint all new flashings
- remove debris.

Ease and adjust shall include:
The term ease and adjust as applied to doors, cupboard doors, casement sashes and the like includes:
- rehanging on existing hinges
- planing edges as necessary
- oiling locks and hinges and leaving in working order

Overhaul shall include:
The term overhaul applied to doors, cupboard doors, casement sashes and the like includes any or all of the following operations as are necessary:
- cramp up loose tenon joints and wedge or re-wedge including gluing wedges
- piecing in any damaged timber to door, frame and linings or architraves
- rehanging on existing hinges or renewing hinges if required
- plane edges
- plane off protruding tenons
-refix ironmongery and locks or renew if required
- oil locks and hinges
- renew glass where cracked or broken
- renew putties where loose, missing or defective

Strip existing installation shall include:
The term strip existing installation in relation to electrical installation includes:
- disconnecting at mains and making safe
- disconnecting and taking out all existing conduit, wiring and fittings (except where conduit is to be re-used)

Strip existing installations in relation to plumbing and engineering installations shall include:
- turning off incoming supplies
- disconnecting and taking out all existing appliances, fittings and pipework
- removing defunct pipeclips, fixings and the like
- making good walls, floors, ceilings as required
- removing debris.

Strip existing installation shall include:
Specifications
PART 3 SITE CLEARANCE AND GENERAL EXCAVATIONS

3.1 Other Specifications

The Engineering specifications for Excavations and Earthworks also apply to these specifications.

3.2 Codes of Practice

The Contractor shall comply with the following Codes of Practice:

- Site Investigations: C.P. 2001
- Earthworks: C.P. 2003
- Foundations: C.P. 2004
- Protection of building against water from the ground: C.P. 102

3.3 Inspection of Site

The Contractor is deemed to have visited the site and to have ascertained the nature of the soil and sub-soils to be excavated. No claim will be allowed on account of these being of a different nature from that for which he has allowed in his prices.

3.4 Procedure

The excavations and fillings shall be carried out in such a manner and order as the Architect may direct.

3.5 Existing trees and shrubs

Cut down and remove shrubs and trees as directed. No shrubs, trees, plants etc., shall be removed except as directed by the Architect and the Contractor shall be held responsible for any damage caused by the building operations to those shrubs, trees etc., not so directed to be removed and will be required to replace such trees on a like for like basis.

3.6 Site Clearance

All grass, vegetable matter etc., must be removed or burned on site at the commencement of the contract over areas as directed by the Architect.

3.7 White Ant - Insecticide Treatment

The Contractor must destroy any white ants' nests found within the perimeter of the buildings and within a distance of 20 metres from the buildings externally and take out and destroy queen ants, impregnate holes and tunnels with approved insecticide and back-fill with hard material well rammed and consolidated.

3.8 Excavation

i) The excavations are to be executed to the widths shown on the Drawings, and to the depths below existing ground levels as directed by the Architect in order to obtain satisfactory foundations. If the Contractor excavates to any widths or depths greater than those shown on the Drawings or as instructed by the Architect he shall at his own expense fill in such widths or depths of excavation beyond that instructed or shown with concrete to the satisfaction of the Architect.

ii) Level and ram bottoms of all excavations to receive concrete, from steppings if necessary or directed to allow for sloping ground, and well water excavations before pouring concrete.

iii) The Contractor shall report to the Architect when secure bottoms to the excavations have been obtained. Any concrete or other work executed before the excavations have been inspected and approved shall, if so directed, be removed and new work substituted after the excavations have been approved all at the Contractor's expense.

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

3.9 Blasting

No blasting will be permitted without the prior approval of the Architect and Local Authority.

3.10 Borrow Pits

Borrow pits will only be allowed to be opened up on the site on receipt of permission from the Architect.

3.11 Hardcore filling

Hardcore for filling under floors etc., shall be good hard stone, ballast or quarry waste (not Magadi or similar soft stone) to the approval of the Architect broken to pass not greater than a 150 mm ring or to be 75% of the finished thickness of the layers being compacted whichever is the lesser and graded to contain sufficient smaller pieces to fill all voids so that it can be thoroughly compacted. The filling is to be laid in layers each of a consolidated thickness not exceeding 225 mm and well watered and compacted by hand or mechanical tamper. The top surface of the hardcore shall be levelled or graded to falls as required and blinded with a 75 mm layer of similar material finely crushed and well rolled and watered immediately before concrete if laid.

3.12 Filling obtained from the excavations

Filling obtained from surplus excavated materials is to be free from all weeds, roots, vegetable or other unsuitable materials and is to be filled in layers each of not more than 225 mm finished thickness. Each layer to be well watered and consolidated before the subsequent layer is filled in.

3.13 Materials found in the excavations

No sand, aggregate or other materials found in the excavations is to be used in the works without the written permission of the Architect.

3.14 Anti-termite treatment

Anti-termite treatment shall be carried out using Gladiator® or other chemical approved by the Architect in writing diluted to a water emulsion in accordance with the manufacturer's instructions.

The treatment shall be applied to the whole area of the hardcore bed and all surfaces immediately prior to the placing of the DPM to the concrete floor slab.

Treatment shall not be applied whilst it is raining or to surfaces of filling which are wet, and strictly in accordance with manufacturer's instructions.

The contractor's attention is drawn to the fact that this treatment can be toxic to animals and human life, and 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 accordance with the manufacturer’s instructions;
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 retreat 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 retreat as necessary to eliminate any infestation entirely and at his own cost on each occasion that infestation is found.

3.15 Protection of pipes, cables etc.

Before commencing works which include excavations or ground levelling by manual or mechanical excavation the Contractor shall at his expense ascertain in writing from Telkom, K.P. & L. Co. Ltd., Engineer’s Department (Water & Sewers section) and all other public bodies, companies and persons who may be affected, the positions and depths of their respective ducts, cables, mains or pipes and appurtenances. He shall thereupon search for and locate such services.

The Contractor shall at his own expense effectually prop, protect, underpin, alter, divert, restore and make good as may be necessary all pipes, cables or ducts, poles or wires and their appurtenances disturbed or damaged during the progress of the works, or in consequence thereof.

Except that such services as required to be removed or altered by virtue of the layout of the permanent work and not the manner in which the work is carried out, shall be so removed or altered at the expense of the Employer.

The Contractor shall be liable for the cost of repairs to any services damaged as a result of carrying out the works and shall further be liable for any damage which may be shown during the period of maintenance, to have arisen through the execution of these works.

3.16 Rates for excavations

The rates for excavation, including excavation in rock, must include for trimming, levelling and preparing bottoms and all faces to receive concrete, etc., and for any extra excavation required for planking and strutting.

Prices shall include for excavating in any material encountered unless specifically otherwise described, handling, etc., of extra bulk after excavating, or before consolidating, any extra excavation required for formwork or planking and strutting, circular work, grubbing up any old drains, roots, etc., that may be encountered, for trimming sides and levelling and ramming bottoms, forming steepings and trimming excavation or filling of embankments and batters as required.

In his price for the item “Keep excavations free from all water” the Contractor shall allow and make provision for keeping the whole of the work thoroughly drained and clear of water below the lowest level of any part of them so long as may be required and if considered necessary by the Architect, continuously day and night by petrol or hand pumps or other mechanical appliances, pipes, chutes, dams, manholes, sumps, diversions or any other means necessary for the purpose. Water pumped from the trenches shall not be allowed to run down the road channels but shall be conveyed to the nearest surface water sewer, ditch or river through troughs, chutes or pipes.

3.17 Rates for disposal

Rates for disposal of excavated material are to include for the selection of spoil as it arises and for all double handling and re-excavation from spoil heaps not specifically ordered by the Architect.

3.18 Polythene sheeting

Polythene sheeting shall be 1000 gauge obtained from an approved manufacturer. Joints in sheeting shall be treble folded with 150 mm fold and taped at 300 mm intervals with 50 mm wide black plastic adhesive tape as manufactured by Sellotape Limited. The sheeting shall not be stretched but shall be laid loose with sufficient wrinkles to permit shrinkage up to 15%.

3.19 Grassed areas

Areas to be grassed shall be cleared of all debris, stones and roots and dug up to a depth of 300 mm.

Where outcrops of rock or murrum occur, these will be covered with suitable soil to a depth of 150 mm.
PART 4 WALLING

MATERIALS

4.1 Cement

Cement used for making mortar shall be as described in the Engineering specifications for "Materials".

4.2 Lime

The lime for making mortar shall be obtained from an approved source and shall comply with BS 890 Class A for non-hydraulic lime. The lime to be run to putty in an approved lined pit or container. The water to be first run into the pit or container and the lime to be added until it is completely submerged, stirred vigorously until all lumps are disintegrated and shall be kept constantly covered with water and regularly stirred for at least four weeks. The resulting milk-lime then to be run through a fine sieve and run into a pit or other container and kept clean and moist for not less than two weeks before being used in the works.

4.3 Sand

Sand used for making mortar shall be clean well graded siliceous sand of good sharp hard quality equal to samples which shall be deposited with and approved by the Architect. It shall be free from lumps of stone, earth, loam, dust, salt, organic matter and other deleterious substances, passed through a fine sieve and washed with clean water if so directed by the Architect.

4.4 Water

Shall be as described in "Concrete Work".

4.5 Concrete Blocks

Concrete blocks shall comply with the requirements of BS 2028, 1364 except where amended or extended by the following clause. Blocks shall have square arises and corners. For fairfaced work damage to arises and corners shall not exceed the removal of 6 mm of the blocks depth or thickness. Concrete blocks shall have a minimum crushing strength of 3.5 N/mm² except when below the damp course level or in contact with soil when they shall have a minimum crushing strength of 7 N/mm², unless noted otherwise on drawings. Hollow concrete blocks shall not be used below the damp course level or in contact with soil.

Concrete blocks used for external walls shall be Class ‘A’ and for internal load bearing walls they shall be at least Class ‘B’. Class ‘C’ blocks shall only be used for non-load bearing partitions.

No precast blocks shall be incorporated into the works unless approved by the Architect. The delivery of present blocks from which samples tested do not comply with this specification shall be deemed defective. Any work constructed with blocks from which samples tested do not comply with this specification shall be deemed to be defective.

From every 1,000 precast concrete blocks delivered to site ten blocks samples shall be provided for testing. The precast block samples shall be selected in accordance with BS 2028, 1364. Samples of precast concrete blocks for testing shall be tested for the following properties in accordance with the methods given in BS 2028, 1364 and the test results shall comply with the requirements of BS 2018, 1364 except where amended by this specification:

- (a) Drying shrinkage
- (b) Compressive strength or transverse breaking load (as applicable)
- (c) Wetting expansion *
- (d) Density
- (e) Dimensional Tolerance
- (f) Cavity size

*Test only applicable for concrete blocks made with clinker aggregate.

Blocks shall also be tested to determine the suction rate. The test shall consist of weighing the block, placing in a tray of water such that only 3 mm of the block side is immersed for a period of sixty seconds +/- 2 seconds; quickly wiping off excess water and reweighing. The suction rate is the increase in weight due to water absorbed and shall not exceed 2kg/m²/minute. Blocks which have a suction rate exceeding 2kg/m²/minute may be used if the Contractor uses an approved water reactive additive in the mortar or can show that the blocks are wetted such that the blocks will have a suction rate not exceeding 2kg/m²/minute for a period of 24 hours from being laid and provided the blocks comply with all other requirements.

Concrete blocks shall be stacked on prepared dry areas free of clinker, ashes and sulphate bearing strata. Blocks of different strengths shall be stacked separately and clearly marked to differentiate the strengths.

Blocks shall not be used for a minimum of 7 days after manufacture and shall not be loaded for at least 14 days after laying. For the first 7 days after manufacture, blocks shall be cured by maintaining in a damp condition, e.g. covering with polythene sheeting after wetting blocks.

4.6 Hollow Clay Blocks

Hollow clay partition blocks shall comply with the provisions of BS 1190 Section 1 and are to be hard, well burnt, true to size and shape and with sharp arises and keyed faces and joints and are to be obtained from an approved manufacturer and to be equal in every respect to a sample to be deposited with, and approved by, the Architect.

Blocks are to be 190 mm high (to give 200 mm course height including the joint) and of the thickness given herein. Cutting of blocks is to be avoided wherever possible and full use is to be made of quarter, half and three-quarter blocks, and blocks with conduit recesses.

SPECIFICATIONS WALLING

SPECIFICATIONS 2/5
4.7 Louvre Block Walling

i) To be precast concrete mix 1:1.5:3 or 25 N/mm² (12 mm aggregate) but with 10 mm finished fair on all exposed surfaces, built in cement and sand (1:5) mortar with straight horizontal and vertical joints to flush pointed both sides.

ii) Each block to be size 200 mm x 400 mm x 200 mm high and consisting of two ends each 200 m x 200 mm x 50 mm thick joined with a 50 mm thick twice cranked louvre with top end of louvre projecting 40 mm above tope of block.

4.8 Stone

All stone shall comply with the requirements of CP 121.202 for masonry and rubble walls respectively except where amended or extended by the following clauses.

Unless otherwise noted, all masonry walls shall be coursed squared rubble walling with mortar joints.

The size of stones for rubble walling shall be such that the length of stone does not exceed three times its height. For coursed squared rubble walls blocks shall not exceed 300 mm in height and shall be not less than 150 mm in height.

Where snecked rubble walls are specified, the snecks shall not be less than 100 mm square on the exposed face.

Stone for masonry shall have a minimum compressive strength of 10 N/mm². (Stone shall not be required to be tested to failure). The density of stone for masonry shall be not less than 2300 kg/m³. The drying shrinkage of stone shall not exceed 0.05%.

Samples of stone provided for testing shall be tested for the following in accordance with the methods given in BS 2028, 1364 and the test results shall comply with the requirements of this specification.

(a) Compressive strength
(b) Density
(c) Drying shrinkage

The colour and texture of stone shall be uniform and consistent. Prior to delivering any stone to site, the Contractor shall supply the Architect with a sample of stone in order that he may approve the colour and texture. The Contractor shall ensure that sufficient suitable stone is available for the whole of the project prior to ordering the stone.

Where cast stone including stone described as artificial stone, reconstructed stone, etc., is specified the stone shall comply with the requirements of BS 1217.

Masonry shall be of stone, having no irregular faces and only the back face if not visible shall be left as from the saw.

Prior to ordering dry stone the Contractor shall demonstrate that the stone is durable. This may be done by supplying details of buildings constructed with stone from the same quarry and which has been exposed to the same environmental condition for at least ten years.

The maximum projection from the face of stone for rubble walls shall be 20 mm beyond the specified face of the wall.

The Contractor shall provide six samples of stone measuring 150 mm x 150 mm for testing prior to delivering any stone to site. As work proceeds the Contractor shall provide six samples 150 x 150 x 150 mm for testing from every 300 m² of work.

All stone shall be stacked on prepared dry areas free of clinker, ashes and sulphate bearing strata.

4.10 Fire Bricks

Clay fire bricks shall be obtained from an approved source and shall be hard, sound, square and clean well burnt and in respect of size shall comply with BS 3921 : 1974 Section2.

4.9 Wall Reinforcement

100mm Thick walls and where described other walls and partitions shall be reinforced with a 25 mm wide strip of No. 20 S.W.G. hoop iron built into alternate horizontal joints in the wall centre. The reinforcement shall be lapped and hooked at running joints, angles and intersections and carried at least 115 mm into abutting walls at junctions.

4.11 Wall Ties

To be 3 mm diameter galvanized mild steel wire twisted butterfly wall ties.

4.12 Damp-Proof Courses

The bituminous felt sheeting for damp-proof courses shall be hessian based bituminous felt complying with BS 743 type 4A weighing not less than 3.85 Kgs. per square metre. The sheeting is to be lapped 150 mm at running joints and the full width of walls at angles.

WORKMANSHIP

4.13 Cement Mortar

Mortar described as cement mortar 1:4 shall be composed of 1 cubic metre (1498 Kgs.) of Portland cement and 4 cubic metres of sand. Other mixes such as 1:3, 1:5 etc. shall be similarly construed.

4.14 Mixing of Mortar

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. No partially or wholly set mortar will be allowed to be used or re-mixed.

4.15 General Construction

(a) Setting out

The Contractor shall provide proper setting out rods and set out all work on same for course, openings, heights etc., and shall build the walls, piers etc., to the widths, depths and heights indicated on the Drawings and as directed by the Architect.

(b) Building in Wood Frames

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

(c) Building in Metal Windows and Doors

Openings for metal frames are to be wide enough for the frames to fit without being forced into position. Build the lugs into the joints of the walling and fill in the space between the walling and frame with cement mortar well tamped into the channel of the frames and point all round externally.

All frames must be set plum and level and free from twist.

(d) Walls to Receive Plaster & Similar Finishes

All faces of walls to be plastered etc., to have all projections dressed off and joints raked out as key.

4.16 Building Walling

(a) Laying and Jointing

All blocks shall be well wetted before being laid and the top of walling where left off shall be well wetted before commencing building. Walls to be kept wet three days after building. All walls throughout the works shall be carried up evenly in 200 mm courses except where courses of less depth are required to bring walling up to level of floors, windows and the like and where otherwise described, no part being allowed to be carried up more than one metre higher at one time than any other part and in such cases the joining shall be made in long steps so as to prevent cracks arising and all walls shall be levelled round at each stage. Not more than 3 metre height of wall shall be laid in any one day.

(b) Bonding

The blocks shall be properly bonded together and in such manner that no vertical joint in any one course shall be within 115 mm of a similar joint in the courses immediately above or below. All walling of 300 mm thickness or less shall be built in single thickness of blocks. Walling exceeding 300 mm in thickness shall be built with through bonders not more than 1070 mm apart in each course as directed by the Architect.

Alternate courses of walling at all angles and intersections shall be carried through the full thickness of the adjoining wall. All perpends, reveals and other angles of the walling shall be built strictly true and square.

(c) Tolerances

All courses of walls shall be level with a maximum deviation of +/- 3 mm in any one metre length and a maximum overall deviation of 10 mm for lengths of wall exceeding 3 metres. Walls shall be plumb with a maximum deviation of +/- 3 mm in any metre height of wall with a maximum deviation of +/- 10 mm in the total height of the wall or any storey.

All corners of walls which are shown as being at right angles shall be square with a maximum deviation of 3 in 1000. All walls shall be straight with a maximum deviation of +/- 3 mm in any one metre length and a maximum overall deviation of 10 mm in any length exceeding 3 metres.

All bed and vertical joints shall be an average of 10 mm thick with a maximum deviation of +/- 3 mm of blockwork, and stone rubble walls. Joints for stone masonry walls shall be 6 mm +/- 1 mm thick.

(d) Curing

All walls shall be maintained in a damp condition for at least 24 hours after laying. Walls under construction shall be dampened by applying water with a brush and no hosing directly on to the wall shall be permitted. When work ceases on any section of wall polythene or hessian shall be draped over the wall, for at least 24 hours. If hessian is used, it shall be maintained continuously wet.

(e) Cavities

Cavity walls shall be of the overall thickness shown on the drawings.

Cavities above ground level between leaves of block or masonry shall be free of mortar droppings or other debris. The Contractor shall take proper precautions to prevent mortar or debris entering the cavity.

Cavities below ground level shall be filled with mortar for cavities up to 75 mm wide and for cavities over 75 mm wide filling shall be concrete mix 1:3:6. Cavities shall be filled such that there is maximum of three times the thickness of the thinner leaf of the wall filled with wet mortar or concrete unless the wall is continuously supported for the depth.

(f) Backfilling

Earth backfilling against walls shall be carried out such that the level of the backfill is always equal on each side of the wall.

When a wall has filling material on one side only to a fill width of more than three times the wall thickness, the wall shall be continuously supported during backfilling.
Backfilling shall not be carried out until at least seven days have elapsed since the laying of the blocks or stone.

4.17 Reinforced Walls

Steel reinforcing bars in walls shall be carefully placed and spacers used to ensure that a minimum of 20 mm cover is given to the reinforcement unless otherwise specified.

Horizontal reinforcement in mortar joints shall be laid such that the reinforcement is not in contact with the blocks or stone.

4.18 Wall Ties

Wall ties shall be provided to connect walls to steel or concrete columns and beams to connect two unbonded leaves of wall.

Wall ties shall be provided at 450 mm centres both vertically and 900 mm centres horizontally and shall be staggered when used to connect two leaves of unbonded wall. Wall ties shall be embedded into each material by a minimum of 50 mm.

4.19 Fair Face

All concrete and hollow clay blockwork described as finished with a fair face is to be built to a true and even face with the joints finished as specified hereinafter.

4.20 Pointing

Pointing of walls shall be carried out as the work proceeds wherever possible. When coloured mortar is specified for pointing only the pointing shall be carried out after work has been completed.

Existing walls shall be prepared for pointing by raking out all loose friable material to a minimum depth of 15 mm to form a square recess. The joints shall then be wetted and new mortar shall be forced into the joints and finished as directed.

4.21 Holes, Cutting and Chasing

(a) All putlog holes shall be not less than one course deep and carefully filled with a block cut to fit size of opening with beds and joints filled with mortar well tamped in after scaffolding is removed, and if in faced walls tomcatch facing.

(b) Where walling is cut, holed or chased for conduits, pipes and the like all such cuttings etc., shall be filled in solid with cement mortar (1:4) prior to the application of finishes.
PART 5 ROOFING AND RAINWATER DISPOSAL

5.1 Galvanized steel pre-painted roof sheeting

Galvanized steel pre-painted roof sheeting shall be 0.7mm thick IT5 Resincoat pre-painted box profiled galvanised steel sheets as manufactured by GALSHEET KENYA LIMITED or other equal and approved and shall be laid and fixed strictly in accordance with the manufacturers printed instructions. The Resincoat finish is to be alkyd urea type stoving enamel consisting of two coats to the external face and one coat to the internal face to a colour to the approval of the Architect, which may not be a standard Resincoat colour and may be a special colour.

The sheets shall be fixed to steel Z purlins using 6mm diameter galvanised hook bolts with rubber caps. Holes shall be drilled through the ridges of the corrugation and not the hollows. No damaged or scratched pre-painted sheets will be accepted on site and any such sheets will be replaced at the Contractor's expense.

Sheeting shall be laid with end laps of 200 mm and one corrugation side laps on the side away from the prevailing wind.

Where shown on the drawings single length roof sheeting shall be provided without any end laps and the contractor shall allow for ordering the required length and for any additional costs associated therewith. Such sheet lengths will be approximately 12.5 metres long.

Ridges and other accessories shall be supplied as shown on the drawing and shall be fixed to timber or steel purlins as above described.

5.2 Proprietary accessories and closures to steel roof sheeting.

Proprietary metal ridges, flashings and end closures to fit IT5 profiled sheets with a pre-painted resincot finish of matching colour to the roof sheets are to be provided where specified on the drawings or described in the bills of quantities. Fixing shall be undertaken in accordance with the manufacturers instructions.

Polyurethane foam poly closures as supplied by Galsheet Kenya Limited or equal and approved shall be fixed underneath ridge cappings and at eaves between the purlin and roof sheeting.

5.3 Sealant to galvanized steel roof sheeting

Where specified on the drawings and described in the bills of quantities a sealant is to be applied to the side and end laps of each roofing sheet.

The sealant shall be a silicone sealing strip size 5 x 9mm as supplied by Galsheet Kenya Limited or other equal and approved and fixed in accordance with the suppliers printed instructions.

5.4 Insulation foil underlay

Insulation foil underlay shall be equal to Super Sisalation as manufactured by Laminated and Coated Products, South Africa and supplied by Galsheet Kenya Limited. Multi-purpose 405 underlay shall be laid under concrete tile roofs and heavy duty 420 underlay under IT5 steel roof sheeting with strainer wires.

The insulation foil shall be fixed in accordance with the manufacturers printed instructions under the IT5 or roof tile coverings. Strainer wires shall be provided between purlins to support the insulation foil which is to be laid level horizontally and fully lapped.

The contractor may propose an alternative product to the Super Sisalation for the Architects approval provided the alternative proposed is equivalent to or better than the Super Sisalation specification.

5.5 Concrete roofing tiles

Concrete roofing tiles are to be as manufactured by Manson Hart Kenya Ltd or other equal approved. Tiles are to be either 380 x 230mm standard roll mark I smooth finish tiles with through colour and spray on finish or 420 x 330mm bold roll mark II smooth finish tiles with through colour and spray on finish. Generally, the smaller tile is to be used to the verandah roofs and the larger tile to the main roofs as shown on the drawings. Matching accessories including ridge tiles are to be supplied by the manufacturer.

Tiles are to be in colours selected by the Architect and all ridges and other special tiles must be from the same manufacturer and must match the tiles with which they are laid. Samples are to be provided.

All tiles are to be laid to the correct gauge on treated sawn timber battens each slope of the roof being sent out to take an exact number of whole tiles without any cutting at ends and with straight joints true from top to bottom.

The top and bottom courses, every fifth course and verge tiles to be nailed using 50mm galvanised nails.

At verges special left hand verge tiles are to be used.

Ridge and hip tiles are to be bedded in cement mortar (1:4) and visible joints pointed in matching coloured compound obtained from the tile manufacturer.

Any cutting on tiles and specials shall be accurately executed with a power driven masonry saw and any exposed raw edges coloured with compound as before described.

No cracked, chipped or otherwise broken tiles will be allowed in the Works and all tiles discoloured or defaced by mortar droppings are to be replaced at the contractor’s expense.

Before delivering up the works, the contractor shall examine the roof coverings and leave the roofs clean, water-tight and drop dry.
SPECIFICATIONS

Tiles are to be uniform in size, shape and colour, hard and free from defects, fittings and accessories must match the tiles.

Battens are to be as recommended by the manufacturer and minimum end lap shall be 75mm as necessary to avoid cutting tiles at eaves or ridges. Battens are to be in lengths exceeding 1500mm and fixed with 7mm screws to each rafter.

5.6 Metal roof flashings

All metal flashings to be formed in 24 gauge galvanised steel primed in calcium plumbate or red oxide primer with matt painted finish, formed to profile as shown on the drawings, including sleeve flashings to soil and vent pipes and roof protrusions. Cut edges must be primed in calcium plumbate or red oxide primer with matt painted finish to prevent rusting.

5.7 Valley gutters/secret gutters

Valley gutters to be formed in painted 18 gauge pressed metal galvanised steel profiles, fully supported over entire length with timber branderings. Cut edges must be primed in calcium plumbate or red oxide primer with matt painted finish to prevent rusting.

Secret gutters to be formed in 4mm pressed galvanised steel sheet, suitable for maintenance access, and fully supported over its entire length with t&g boarding, with personnel safety wire and bolt fixings to detail as drawings.

5.8 Roman clay tile roofing

Roman clay tiles shall be obtained from Kenya Clay Products or equal approved.

Clay tiles shall be uniform in shape and size well burnt, of even colour and free from cracks and other defects. Samples of the tiles the Contractor proposes to use are to be provided to the Architect for his approval. Tiles subsequently supplied shall be equal in all respects to those approved by the Architect.

Tiles are to be laid in level horizontal courses with 75mm end laps between adjacent horizontal courses. Tiles are to be laid reverse overlapping in vertical courses at 110mm centres between adjacent vertical courses.

On concrete roofs of 36 degrees slope Roman tiles are to be fixed to 75 x 50mm pressure impregnated timber battens fixed at 220mm centres under the reverse tile of vertical courses. Tiles are to be fixed in every third horizontal course with galvanised nails.

Where Roman tiles are fixed to timber roofs fixing shall be as specified for concrete roofs of 36 degrees slope.

Ridges and hips of Roman tiles are to be bedded in cement mortar and flush pointed.

5.9 Underfelting

Underfelting as specified by the Architect is to be provided to all tiled roofs and fixed under roofing battens with 150mm laps.

5.10 Modified bituminous roofing membrane

Modified bituminous roofing membrane shall be a reinforced plastomerici polymer-bitumen waterproofing membrane type as Index Fidia and Columba types or equal approved. Felt thickness is to be 4mm with a mineral surface finish.

The membrane is to be applied in strict accordance with the manufacturers instructions including side and end laps.

Before commencement of the roofing membrane works the contractor shall submit to the Architect for his approval the method of application of the membrane.

All work shall be executed by a firm approved by the Architect.

SPECIFICATIONS ROOFING & R.W. DISPOSAL

The contractor shall, as and when required by the Architect, submit and deliver samples of any materials for testing.

The contractor is to obtain from the approved subcontractor a statement in writing to the effect that the screed and/or under bed is clean and otherwise satisfactory before the coverings are laid. A copy of the statement is to be forwarded to the Architect.

After completion of the roofing membrane works the contractor shall test all the roof areas for water tightness and leakage by blocking the rainwater outlets, filling the roofs with water and monitoring and testing over a forty eight hour period.

The contractor is to provide a written guarantee and undertaking to the effect that during a period of ten years from and after the certified date of Practical Completion of the Works, he shall at his own expense, make good to the approval of the Architect all and any leakage or defects in the work which shall be attributable to improper materials or faulty workmanship, and shall bear the cost of any consequential damage.

This guarantee in no way compromises or indemnifies the manufacturer’s guarantee for the material.

5.11 Roof screeds generally

Roof screeds are to be laid to a minimum falland crossfall of 27 mm in 3.0 metres with a minimum thickness of 19 mm at rainwater outlets and are to be finished to the entire satisfaction of the subcontractor executing the roofing.

5.12 Cement and sand roof screeds

The roof screeds shall be formed of cement and sand (1:3). The screeds shall be laid in bays, square where possible, of maximum 10 square metres. Each bay shall be formed between stop
boards of the correct height and cut on each side to indicate the slope required in the roofing. The screed shall be trowelled with a wood float to true and accurate falls or crossfalls up to the stop boards. A 10 mm wide gap shall be left between each screed bay for the full depth of the screed.

The screeds shall be allowed to cure thoroughly to attain maximum shrinkage. Any cracks which appear due to shrinkage shall be made good.

The gaps between the screed bays shall be filled as follows:

1) Brush or blow out joints to remove dirt, dust, etc., and prime the sides of the joints using a piece of sponge or similar dipped in a mixture of equal volumes of "Finkkote" Type 1 or Type 3 emulsion and water. Allow to dry.

2) Fill up joints slightly proud on the surface using a 1:2:3 mastic. This mastic shall be prepared by mixing one volume of cement with three volumes of sand, adding a little water to dampen the mix, then adding two volumes of "Finkkote" Type 1 or Type 3 emulsion. The mastic is thoroughly mixed together adding further water as necessary until it is a uniform brown colour, without being too sloppy. Allow to set and dry.

The screed joints shall then be covered with a 200 mm wide strip of building paper not bonded to the screed joint and well lapped at angles and junctions before the application of the roof covering.

5.13 Lightweight roof screeds

Lightweight roof screeds shall be composed of bases of cement, sand and pumice (1:4:8) finished with a 12 mm cement and sand (1:5) topping laid whilst the base is still green and trowelled smooth to the satisfaction of the Architect.

The screeds are to be laid as described in 'Cement and Sand Roof Screeds'.

5.14 PVC rainwater pipes

PVC rainwater pipes and fittings are to comply with BS 4576 with rubber ring seal joints.

Pipes are to be fixed to the structure with PVC holderbats or brackets built-in or plugged and screwed at maximum 2 metre centres.

Bends, swan necks, discharge chutes and fittings generally are to be fixed where necessary to facilitate the flow of water.

Rainwater outlets shall be PVC suitable for the roof finish in which they occur with domical PVC grating.

5.15 Steel rainwater pipes and gutters.

Steel rainwater pipes and gutters are to be 6mm thick steel obtained from an approved manufacturer and finished with calcium plumbate primer.

5.16 Fulbora rainwater outlets

Fulbora rainwater outlets shall be manufactured by an approved manufacturer to the sizes and profiles manufactured from heavy grade cast iron, including grating, with a minimum 75mm wide flange all round. The top fixing to roof surfaces, is to be fully bedded in hot bitumen and jointed to the PVC or steel rainwater pipes.

5.17 Testing rainwater installations

Rainwater installations shall be subjected to a water test and proved capable of withstanding a pressure of 1.05m head of water to the approval of the Architect. Any defects are to be made good by the contractor and the whole system left sound and perfect.

5.18 Guarantee

The contractor is to leave all the roofs complete and watertight, unmarked with cement or bitumen particularly flashings and external finishes and with joints in straight and even lines.

Unless otherwise provided for in the Bills of Quantities, the contractor must submit to the Employer prior to the date of Practical Completion a ten year guarantee for the roof coverings against leakage.

5.19 Protection

The contractor is to take all necessary precautions to protect the finished work and must ensure that no damage occurs to the roofing until completion of the works.

5.20 Completion of the works

On completion of the works, the contractor shall clear away, ensure that rainwater outlets are clear and generally leave the roof areas in a clean and watertight condition to the satisfaction of the Architect.
PART 6 CARPENTRY AND JOINERY

6.1 Generally

All woodwork shall be carried out in accordance with the drawings and the principals of first class joinery construction. Unless specifically stated otherwise, sizes shown on drawings are finished sizes and the Contractor must allow for wrot faces.

MATERIALS

6.2 Qualities of timber

(a) The qualities of timber stated hereinafter are in accordance with the latest Kenya Government Grading Rules.

(b) All timber described as Prime Grade is to be First Grade (Grade 1).

(c) All timber described as Selected Grade is to be Second Grade (Grade 11).

(d) All hardwood is to be Prime Grade (Grade 1).

(e) All timber for permanent work in the building shall before use be approved by the Architect for quality in accordance with the foregoing specification for its respective grade. Any timber not so approved by the Architect shall be removed from the site forthwith.

6.3 Insect damage

All timber, whether graded or ungraded, and including shuttering, scaffolding and the like shall be free of live borer beetle or other insect attack when brought upon the site. The Contractor shall be responsible up to the end of the maintenance period for executing at his own cost all work necessary to eradicate insect attack of timber which becomes evident including the replacement of timbers attacked, or suspected of being attacked, notwithstanding that the timber concerned may have been inspected and passed as fit for use.

6.4 Seasoning of timber

All carpentry timbers are to be seasoned to an average moisture content of not more than 20%. All joinery timbers are to be seasoned to an average moisture content of not more than 15%. The Contractor is to make available on site a meter for testing moisture content of all timber delivered.

6.5 Preparation and protection of timber

(i) All timber necessary for the works is to be purchased immediately the contract is signed, and when delivered is to be openstacked for such further seasoning as may be necessary. Preparation of the timber is to be commenced simultaneously with the commencement of the works generally.

(ii) All timber and assembled woodwork is to be protected from the weather and stored in such a way as to prevent attack by decay, fungi, termites or other insects.

6.6 Species of timber

Only those timbers specified are to be used for the works, unless alternatives are authorised by the Architect in writing.

6.7 Pressure impregnated timber

(i) All timber described as "pressure impregnated" shall be impregnated under vacuum and pressure with "Celcure" or "Tanalith" wood preservative with an average absorption of not less than 6.7 Kgs. of dry salt per cubic metre. In case of resistant species where this retention cannot be obtained the timber shall be treated to refusal point. All treated timber shall not be exposed to wet conditions for at least 14 days after treatment has been carried out. All cut ends, drilling or fabrications on the site producing new surfaces shall be thoroughly brushed or soaked with "Celcure B" salts applied in accordance with the manufacturer's instructions.

(ii) Any other method of timber impregnation will only be allowed at the Architect's approval.

6.8 Hardwood

All hardwood will comply with the requirements of BS 1186 Part 1 and BS 4047. It shall show a straight and regular grain throughout.

Hardwood shall be free from wooly texture, soft heart, sap wood, splits, shakes, all evidence of insect or fungi attack and rot and all faults caused by compression failure. There shall be no waney edges. Hardwood shall be free from knots on exposed faces. Any hardwood showing visible imperfections will be rejected.

Preservatives shall not be used without the Architect's permission. Where indicated on the drawings, internal hardwoods will be treated with clear sealants as specified elsewhere.

6.9 Softwood

Softwood timber for carassing work shall be either Podocarpus or Cypress to the approval of the Architect and shall be to the dimensions specified on the drawings.

Timber shall be classified in accordance with the Groups listed in this Clause.

All softwood shall comply with the requirements of BS 1186 Part I. Timber shall be free from wooly texture, soft heart, sap wood, splits, shakes, pith showing on the surface, sloping grain exceeding one in eight checks, knots exceeding 25 mm diameter, loose knot or knot holes and any evidence of insect or fungi attack. There shall be no waney edges.

Where indicated on the drawings, the softwood will be treated with clear sealer or painted with gloss paint.

All softwood is to be pressure impregnated against insect attack before delivery to site. Any ends cut after treatment shall be given two liberal coats of preservative.

6.10 Plywood

All plywood shall comply with the requirements of BS 1203 grade WBP.

Plywood shall be free from end joints (including joints in veneers) overlaps in core veneers, dead knots, patches and plugs, open defects, depressions due to defects in cure, insect attack (except isolated pinworm holes through face veneers only), fungal attack and from discoularation differing from that normally associated with species.

Face veneers shall be hard and durable and shall be capable of being finished to a smooth surface. Face veneers shall closely match the general joinery timber supplied.

6.11 Chipboard

Chipboard shall be medium density wood particle board complying with BS 2604 Part 2, produced in factories by an approved process.
6.12 Blockboard
Blockboard shall be of approved local or imported manufacture to BS 3444 glued throughout and softwood or hardwood faced as hereinafter specified and equal to a sample to be deposited with the Architect for approval and which when so approved shall form the standard for the works.

6.13 Fibreboard
Shall be insulating board to comply with BS 1142 of the types specified and of approved manufacture.

6.14 Medium density fibreboard
Medium density fibreboard (MDF) shall be obtained from an approved manufacturer. Panels are to have a moisture content of 6% and the contractor shall provide to the architect for approval a manufacturers certificate of origin and detailed specifications of the manufacturers board.

Routed finish to boards is to be finished by the manufacturer at the factory.

6.15 Tempered hardboard
To be of approved manufacture according to all respects with BS 1142, suitable for painting, prepared and fixed in accordance with the maker’s instructions.

6.16 Timber doors
Doors are to be designed, manufactured and fixed in accordance with the relevant British Standards summarised below:

BS 476 part 8 1972 Fire tests etc.
BS 4787 part 1 1972 Door dimensions etc.
BS 1186 part 1 1971Quality of timber and workmanship
BS 1227 part 1 A Hinges
BS 3827 Builder’s hardware - glossary

6.17 Flush doors
Flush doors shall be of the sizes and thickness indicated in the Bills of Quantities and shall comply in all respects with BS 459 Part 2 and as shown on the drawings.

a) Core shall be GJ grade.
b) Facing is to be 6mm thick MDF board, veneered as specified.
c) Hardwood lipping to be 25mm thick tongued on back face into stiles and rails of core, mitred at angles and glued in.
d) Semi-solid core shall be of 75mm wide stiles, top and bottom rails all framed together with two 450mm x 150mm lock blocks framed in and 20mm intermediate horizontal rails at 60mm centres stub tenoned in each end to stiles. Each horizontal rail and top and bottom lipping to have 10mm diameter hole bored through to ensure air circulation through core.
e) Solid core to consist of 75mm stiles top and bottom rails with solid core of 13mm horizontal strips glued together under pressure. The strips to be put together with the grain alternating and to be tongued on edge and let into vertical grooves in stiles. MDF facing to be 6mm thick.
f) Flush doors may be imported or of local manufacture but in either case a sample must be approved by the Architect before an order is placed and all doors must be equal to the approved sample.

6.18 Fire Check Flush Doors
Fire check flush doors shall comply in all respects other than the following modifications with BS PD 6512 Part 1.

a) To be of the thickness and size stated in the Bills of Quantities.
b) Core shall be 24mm fibre cement.
c) Hardwood lipping to be 25mm thick tongued on back face into stiles and rails of core mitred at angles and glued in.
d) The core to be constructed of 50mm wide stiles and top and bottom rails. Each side to be fitted with 6mm fibre cement lining let in flush to stiles and rails and faced with 1.6mm plastic sheeting.

6.19 Hardwood veneers
(a) Veneer facings shall be selected to the approval of the Architect.
(b) No glass or synthetic fibre stitching will be permitted for jointing veneer leaves together.
(c) Veneers shall be free from splits, dots, glue, stains, insect or fungi attack and rot.
(d) Filling or inlaying of any kind will not be accepted.
(e) All wood veneers shall be bonded to the core material in such a way that no lifting and blistering shall occur.

(f) All hardwood veneered boards shall have 12mm or 25mm matching hardwood lippings.

6.20 Laminated plastic veneers
Laminated plastic veneers shall be a decorative sheet 1.6 mm thick complying with BS 3794 Class 2. The pattern will be selected by the Architect. The laminate shall have decorative (pattern) finish on one face only. Patterns will be selected from the manufacturer’s standard range.

6.21 Wood block floors
(i) To be supplied and laid in 460mmx460mm panels by a specialist all to the approval of the Architect.
(ii) On completion and immediately prior to applying the clear finish, the surface is to be twice machine sanded using first coarse and the fine sandpaper and brushed perfectly clean.

6.22 Miscellaneous material
(a) Tapered timber pellets for filling screw holes must be cut across the grain and shall be of the colour and grain being plugged.
(b) Metal fixing devices must be fully rust-proofed. Cramps, brackets, plugs, bolts etc., must be of a type, make and pattern approved by the Architect.
(c) Adhesives must be suitable for use in the local conditions and be compatible with the materials with which they are in contact.

6.23 Nails and screws
Nails shall comply with BS 1201, screws shall comply with BS 1494 and bolts shall comply with BS 916.

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6.24 Tolerances
The method of construction must accommodate tolerances as shown on the drawings and allow for ensuring that repetitive units can be accurately located in relation to grid lines and that tolerances do not accumulate.

Reasonable tolerance shall be provided at all junctions between joinery and the building.
carcass, whether of masonry or frame construction, so that any irregularities or movement may be adequately compensated.

6.25 Jointing

(a) All joints must be made as specified or detailed and the execution of all jointing shall be to the satisfaction of the Architect.

(b) Joining surfaces of all connections exposed to the weather are to be thickly primed except where gluing is specified. Surfaces are to be in good contact over the whole area of the joint before fastenings are applied.

(c) No nails, screws or bolts are to be placed in any end split. If splitting is likely or encountered in the course of the work, holes for nails are to be pre-bored at diameters not exceeding 4/5 of the diameter of the nails. Glenced nails must be bent at right angles to the grain. Lead holes are to be bored for all screws.

(d) Where the use of bolts and washers is specified the holes are to be bored from both sides of the timber and to a diameter D + D/16 where D is the diameter of the bolt. Nuts must be brought up tight but care is to be taken to avoid crushing of the timber under the washers.

(e) Joints in joinery must 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 nails, sprigs etc., are to be punched and puttyd.

(f) Loose joints are to be made where provision must be made for shrinkage, glued joints where shrinkage need not be considered and where sealed joints are required. All glued joints shall be cross-tongued or otherwise reinforced.

(g) Glues for load bearing joints or where conditions may be damp must be of the resin type. For non-load bearing joints, or where dry conditions can be guaranteed, resin or organic glues may be used.

6.26 Framed work

The word "framed" shall mean and include all the best known methods of joining woodwork together by mortice, tenon, dovetail or other methods, and for forming all necessary stops, mitres or mason’s mitres in members which are moulded, rebated etc.

6.27 Plugging

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SPECIFICATIONS CARPENTRY & JOINERY

Plugging and fixing to walls in all trades shall be executed by "Rawplugging" or similar approved proprietary methods all in accordance with the manufacturer’s printed instructions. Hacking of holes and filling with timber plugs will not be permitted under any circumstances.

6.28 Carpentry work

(a) All carpentry shall be executed with workmanship of the best quality. Scantlings and boards shall be accurately sawn and shall be uniform in width and thickness throughout and shall be as long as possible and practicable in order to eliminate joints.

(b) All work shall be left with a sawn surface except where specified to be wrot.

(c) All work shall be accurately set out and in strict accordance with the drawings, and shall be framed together and securely fixed in the best possible manner with properly made joints. Provide all braids, nails, screws etc., as necessary and as directed and approved.

(d) Actual dimensions of scantlings for carpentry shall not vary from the specified dimensions by more than +3 mm or -1 mm. Sizes and thicknesses of wrot carpentry timbers are nominal, that is to say a variation of 3 mm from the specified sizes will be allowed from each wrot surface unless the thickness or size is described as "finished" in which case no variation from the stated thickness or size will be permitted.

6.29 Joinery work

All joinery work shall be wrot unless otherwise described.

(a) Sizes and thicknesses of joinery are nominal that is to say a variation of 3 mm from the specified sizes will be allowed from each wrot surface unless the thickness or size is described as "finished" in which case no variation from the stated thickness or size will be permitted.

(b) No joinery to be put in hand until the details have been supplied or approved by the Architect and in all cases the details are to be worked to.

(c) All joinery shall be executed with workmanship of the best quality in strict accordance with the detailed drawings, mouldings shall be accurately and truly run on the solid and all work planed, sand-papered and finished to the approval of the Architect. All arrises to be slightly rounded. All framed work shall be cut out, and framed together as soon after the commencement of the building as is practicable but should not be wedged up until the building is ready for fixing the same and any portions that warp, get in winding, develop shakes or other defects shall be replaced with new. In door frames etc., the heart face of the timber shall be fixed away from the wall. As soon as required for fixing in the building the framing shall be glued together with glue as described and properly wedged or pinned etc., as directed.

(d) All beads, fillets and small members shall be fixed with round or oval braids or nails well punched in and stopped. All larger members shall be fixed with screws, the screws let in and pelleted over with wood pellets to match the grain.

(e) Cups and screws for fixing beads and fillets shall be spaced 150 mm apart and 25 mm from angles.

(f) All joinery immediately upon delivery to the site is to be stored and protected from the weather.

(g) All joinery is to be primed before fixing but no work is to be primed until it has been approved by the Architect.

(h) All fixed joinery which is liable to become bruised or damaged in any way, shall be properly cased and protected by the Contractor until completion of the work.

(i) When natural finish is specified, the timber in adjacent pieces shall be matched and uniform or symmetrical in colour and grain.

6.30 Softwood

Fixing shall be by means of non-rusting screws with countersunk heads to proprietary plugs or grounds. Nailing will not be permitted.

Sections shall be neatly and accurately cut so as to avoid splitting of the wood.

6.31 Hardwoods

Hardwoods are as described.

In jointed panels each piece shall be of the same species. Joinery for oiling shall have all surfaces of the same species and same character or grain.

Fixing shall be by means of brass screws with
countersunk heads to proprietary plugs or grounds. Where work is face screwed, heads of screws shall finish not less than 6 mm below the surface and be covered with round teak pellets of appropriate thickness. Pellets shall be chosen and fixed so as to match colour and pattern of grain so far as is practical. Nailing will not be permitted. Sections shall be neatly and accurately cut with fine toothed saws.

6.32 Plywood

Plywood of the required thicknesses shall be used. The Contractor will not be allowed to make up thicknesses by gluing together sheets of thinner plywood.

Where cutting is required it shall be neatly and accurately performed with fine toothed saws so as to avoid splitting the face veneers and intermediate plies.

6.33 Chipboard and MDF boards

Where cutting is necessary it shall be neatly and accurately performed with fine toothed saws so as to avoid splitting the face veneers. Where raw edges arise from cutting these shall be faced with a matching hardwood fillet cut pinned and glued to match factory produced edges.

6.34 Blockboard

Where cutting is necessary it shall be neatly and accurately performed with fine toothed saws so as to avoid splitting the face veneers. Where raw edges arise from cutting these shall be faced with a matching hardwood cut pinned and glued to match factory produced edges.

6.35 Laminated plastic veneer

Laminated plastic veneers are to be fixed with an approved adhesive, care being taken to eliminate all air from beneath the laminate on fixing. The laminate is to be free from chipped or cracked portions and work so disfigured is to be removed and replaced. When the adhesive is set the laminate is to be neatly bevelled off along all arisses with a plane.

Where plastic laminate is fixed to doors or shelves etc., without a laminate to the outer edge, a raised lip is to be provided and the laminate finished flush against the lip.

6.36 Fixing doors and frames

Doors shall be properly fitted to give a uniform clearance of not more than 3 mm all round and hinges shall be let into doors.

Door frames shall be properly framed at angles. Door stops shall be housed into grooves in frames. Architraves shall be provided to conceal finishes. Frames shall be fixed to grounds or plugs. Fixing shall be by means of non-rusting screws with countersunk heads. For hardwood frames screw heads shall be finished not less than 6 mm below surface of the wood and shall be covered with matching round hardwood pellets of appropriate thickness. Pellets shall be chosen and fixed so as to match colour and pattern of grain so far as is practical. Nailing will not be permitted.

Except where indicated doors shall be kept clean for clear polyurethane varnish.

Door frames shall be treated to match doors.

Glazing shall be wired glass 6 mm thick with edges wrapped in washeather and secured with hardwood glazing beads size 10 mm x 15 mm mitred at angles secured with brass screws and cups.

6.37 Construction of doors

(a) Flush doors specified as solid construction shall have a 100% solid core of vertical laminated Cedar or equal and approved.

(b) Flush doors specified as semi-solid construction shall be constructed with timber stiles and rails, infilled with horizontal intermediate rails spaced equally apart and tenoned into the stiles.

(c) Unless otherwise specified, doors scheduled to receive a clear or veneered finish shall be lipped on all edges.

(d) Where panels over doors are specified, such panels shall be constructed in the same way and with the same materials as the doors above which they are situated, and the panels shall match the doors in every respect.

(e) For doors specified as MDF boards faced, the MDF boards shall not be less than 6 mm thick. Face veneers shall be Grade 1 for painted doors.

(f) All doors shall be provided with lock blocks of a minimum size 300 mm x 75 mm.

(g) Glass beading strips shall be approved washeather self adhesive tape turned up over both sides of the glass and glazing surfaces and turned to the straight line.

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(6) All screws shall be countersunk, and screwed and pelleted in un-painted work.

(i) Timber pellets shall be glued and tapped into the hole, making sure the grains line up, and carefully trimmed back flush with joinery to give a clean, smooth overall surface.

6.38 Fittings and fixtures

The fittings, etc., are to be accurately constructed in accordance with the detailed drawings. The doors, drawers, etc., are all to fit and open and close smoothly and all work next to walls, floors and ceilings is to be soundly fixed and screwed to fit snugly against same.

6.39 Mouldings

Moulded work shall be accurately worked to the full size details supplied by the Architect. Mouldings shall be worked on the solid unless otherwise stated.

6.40 Circular work

When circular work is specified it shall be built up with an appropriate number of pieces cut to the required shapes. The pieces shall be put together in two (or three) thicknesses so that they break joint, and shall be secured with hardwood keys and wedges or with hardwood pins (whichever is more appropriate).

6.41 Scribing

Skirtings, architraves, plates and other joinery works shall be accurately scribed to fit the contour of any irregular surface against which they will be required to form a close butt connection.

6.42 Finish

All joinery which is to be oiled and painted shall be finished smooth and cleaned by rubbing down by hand with fine glasspaper.

6.43 Completion of works

Protection of all joinery and ironmongery must be maintained until completion of the contract as a whole.

All joinery and glass is to be thoroughly cleaned before the building is handed over.

6.44 Defective work
All work judged to be defective must be removed and replaced as directed by the Architect.

**IRONMONGERY**

6.45 Generally

(a) Ironmongery shall be fixed with suitable screws in matching finish and prices shall include for this.

(b) All locks and ironmongery shall be fixed before the woodwork is painted, handles shall be removed before the painting commences, carefully stored and refixed after completion of painting.

(c) All locks, springs and other items of ironmongery with moveable parts shall be properly tested, cleaned and adjusted where necessary to ensure proper working order at the completion of the works and left in perfect working order by the Contractor.

(d) The keys of all locks shall have labels attached with door references marked on before handing to the Architect.

(e) All locks shall be provided with a master key system and prices shall include for this as required by the Client and as instructed by the Architect. The client's requirements are to be obtained by the Contractor before ordering.

All locks are to be provided with two keys and no key is to operate any but its own lock except for master keys. All keys are to be provided with a key ring and plastic tag on which is to be firmly written the door reference number.

(f) Unless specified otherwise ironmongery for doors and for aluminium windows to be stainless steel brushed finish or satin anodized aluminium finish.

(g) Where items of ironmongery are not specified by manufacturers catalogue reference, the contractor shall submit proposals for the Architect's approval within one month of the date of commencement of the works. Specifications including manufacturers catalogue reference numbers of the items he proposes to purchase.

(h) Prior to fixing any item of ironmongery, the contractor shall obtain the Architect's approval of a sample.
PART 7 METALWORK

MATERIALS

7.1 Generally
All materials shall be the best of their respective kinds free from defects and all work is to be carried out in the most workmanlike manner and strictly as directed by the Architect. The materials in all stages of transportation, handling and stacking shall be kept clean and prevented from injury by breaking, bending or distortion and weather action.

7.2 Mild steel
Mild steel shall comply with BS 7668-1994.

7.3 Hollow section tubing
Square and rectangular hollow section tubing shall be hot rolled mild steel in accordance with Grade 43C of BS 4360 or the equivalent grade in BS 7668.

7.4 Bolts, nuts and washers
These shall be fabricated from materials which comply with BS 7668 and each manufactured item shall comply with the appropriate BS.

7.5 Galvanized sheet steel
To be No. 24 S.W.G. of approved manufacture to BS EN 10143-1993 of best quality mild steel sheets cold rolled close annealed patent flattened and hot dip galvanized.

7.6 Aluminium
Aluminium shall be extruded sections with an anodised or powder coated finish, either natural or coloured, to give a 25 micron minimum depth to European norm EWAA.

The Contractor shall submit with each item or batch of items delivered, test certificates or such other documentary evidence as the Architect shall require that the depth of anodising or powder coated finish specified has been achieved.

7.7 Stainless steel
Stainless steel shall be Austenitic steel BS 6323 comparable to BS 1449 type 316 S 16.

7.8 Metal door frames
Metal door frames are to be steel to comply with BS 1245 of profile to suit the wall thickness.

Door frames are to be provided with the following:
(a) Two priming coats of paint
(b) Fixing lugs for building into walls
(c) Adjustable lock strike plate
(d) Three galvanized steel hinges per door
(e) Two shock absorber buffers.

7.9 Steel windows
Steel windows shall be manufactured from sections conforming with BS 6510 of heavy duty sections of the metric W20 range of approved manufacture and design approved by the Architect.

After manufacture and before delivery to site steel windows are to be hot galvanized by dipping in a bath of molten zinc or painted with one coat primer.

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7.10 Welding
All welding is to be in accordance with the requirements of BS 5135 and the electrodes shall comply with BS EN 499.

Fusion faces shall be free from irregularities which could interfere with the welding material. These faces shall also be free from any deleterious material such as rust, grease and paint.

All welds shall be of the specified finished sizes and the sequence of the welding shall be carried out in a manner that will give minimum distortion to the welded parts.

Edges of welding shall be prepared by planning or machine flame cutting.

During welding all parts will be maintained in their correct position.

Welds shall be carried out with each run closely following the one prior with sufficient time between to allow for removal of slag.

Each run of weld is to be inspected and the subcontractor shall ensure that unsatisfactory welds are cut out or remade to the required standard.

The minimum size of fillet weld shall be 5 mm.

All completed welds shall have a regular and smooth surface. The weld material shall be solid with complete fusion throughout the weld and to the cutout metals.

Any defects shall be cut out or made good to approval.

External faces of butt welds to be ground smooth.

SPECIFICATIONS METALWORK

7.11 Painting
All steel is to be wire brushed and any loose scale, dirt or grease shall be removed before any painting is commenced. One coat of red oxide primer Type A to BS 2523 shall be applied at the shop.

Any damage to the priming paint shall be made good to the Architect’s satisfaction.

7.12 Fixing of steel windows
Fixing of metal windows shall include for assembling and fixing, including screwing to sub-frames or cutting mortices for lugs in concrete or walling and running with cement mortar (1:4), bedding frames in similar mortar, pointing in mastic, bedding sills, transomes and Mullions in mastic, making good finishings around both sides and fixing, oiling and adjusting all fittings and frames.
PART 8 ALUMINIUM WINDOWS AND SHOP FRONTS

GENERAL

8.1 Scope of Work

The work generally comprises the design, fabrication and installation of fixed and opening glazing shop fronts, windows and doors.

The contractor shall be responsible for the design, sourcing, fabrication, testing, delivery to the works, storage, setting out, installation, removal of any protection, cleaning down, inspection, supervision and co-ordination of the work, all in accordance with the requirements of the drawings and bills of quantities.

Within the scope of the dimensions and general requirements shown on the drawings, the contractor is to propose the type and sections of all extrusions and provide typical drawings of the sections.

The work includes but is not necessarily limited to the following:

(a) Extruded aluminium frames to fixed and opening glazing complete with glass units, and all associated plates, joint sleeves and decorative caps etc., finished in polyester powder coating.

(b) Fixing plates, brackets, minor framing, anchors, screws, bolts, buts and washers etc.

(c) Windows complete with glass units, glazing gaskets and seatings and ancillary glazing components, metalwork finished in polyester powder coating.

(d) External seals and flashings

(e) Finishings in polyester powder coating

The drawings are schematic and indicate requirements only. This specification sets out the minimum standards of performance to be achieved and the minimum standards of materials and workmanship required.

The contractor shall be responsible for developing his design proposals as necessary to provide a detailed solution to the Architect's approval and for ensuring that the whole of the work meets or exceeds the minimum performance levels and materials and workmanship standards specified herein.

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SPECIFICATIONS ALUMINIUM WINDOWS & SHOP FRONTS

Dimensions: The dimensions shown on the contract drawings are structural opening dimensions. It will be the responsibility of the contractor to check all sizes before manufacture commences.

Samples: Before a firm order is placed the contractor will be required to provide, as required by the Architect, samples of extrusions, fittings, ironmongery and typical finished windows for approval.

The work shall comply with the Building Regulations and all current amendments thereto.

The contractor will be deemed to have allowed in the contract sum for full compliance with all current Building Regulations, Local Building Bye-Laws, Safety Regulations, Fire Regulations and all other statutory regulations.

British Standards with current amendments referred to in this specification shall be the latest edition.

Materials and components of foreign origin shall comply with the relevant national standard but shall not be inferior in any way to the quality specified in the most relevant British Standard.

8.2 Inspections and Sample Approvals

The contractor shall allow the Architect and his representative(s) unrestricted access to his office and factory and those of his contractors or suppliers to inspect materials, components, assembled units, manufacturing methods and processes and all related quality control procedures etc. Control samples of all materials to be incorporated in the contractor's works must be submitted to the Architect for approval.

MATERIALS

8.3 Aluminium

Aluminium extrusions shall be from alloys designated 6060, 6063, 6261, 6282 and sheet alloys designated 1200 and 3004 or 5251. The extrusions shall comply with BS 1474

8.4 Powder coated finishes

Certain references under this specification refer to the South African Bureau of Standards (SABS). Powder coating substrates is to be to SABS 1274 – 1979. No powder coating is to be carried out on a fabricated product. Coatings are to be applied by the Powder Coating Process.

All surfaces shall be coated with a nominal thickness of between 50 and 80 microns.

The powder type to be used in the coating process shall be either Interpon D or Vedoc HI-Q or other equal and approved and shall comply with the requirements of BSS 6426 of 1984 with particular reference to Section 2, and moreover carry a manufacturer's guarantee of a minimum of 10 years. This guarantee must be valid in the Republic of Kenya. The guarantee is to be provided by the Architect on completion of the work.

The applicator shall be on the approved list of applicators as published by the powder manufacturer and shall comply with the requirements as stated above.

Colours will be established from the FA2 standard published architectural range.

The gloss level shall be satin.

The process conditions must comply with the requirements of and as described in Section 3 of BS 6496 and where applicable SABS 1274 1979.

The contractor shall immediately repair any damage that occurs by using the repair procedure as recommended by the powder manufacturer. These repair materials are to be confined to the repair of minor scuffmarks or small scratches.

Scratch and blemish inspection will be viewed at a distance of three metres under normal lighting conditions. Normal lighting conditions shall mean reasonable lighting conditions under which the product is normally viewed.1

Scratches in aluminium are defined as being a mark on the aluminium surface which penetrates the painted surface thereby exposing the natural metal. If blemishes are visible when viewed from a distance of three metres under the lighting conditions described, the product will be rejected.

Prior to the installation of the work, a thorough
check is to be made by the contractor for compliance with this specification and he is to submit this in writing to the Architect. This is to include, inter alia:

1. The production of relevant AAAMSA test certificates
2. Proof that the powder coat finishes comply with this specification.

DESIGN AND PERFORMANCE

8.5 General

The work provided shall exclude wind and rain from the building's interior and shall assist in maintaining the desired internal environment. All elements shall be strong enough to resist the forces that are likely to act upon them, but they should achieve this necessary strength and rigidity without adding undue load to the building structure. They shall be durable and perform their functions for the life of the building which will be in excess of 50 years.

8.6 Rainwater penetration

The shop fronts, windows and doors shall be designed, fabricated and installed to prevent leakage to the interior even during periods of heavy rain combined with high winds.

The cladding system in all elements shall incorporate two positive lines of defence against the passage of rainwater to the interior by way of a drained framing system. The space between the two lines of defence shall be drained and ventilated to the exterior.

The outer line of defence shall comprise neoprene, EPDM or silicone gaskets which shall be designed, manufactured and installed to prevent rainwater penetrating into the aluminium framing members/glazing chambers.

8.7 General

The design and construction of the aluminium framing members shall be such that all corner, butt and angular joints which are intended to remain closed are sufficiently strong and rigid to remain completely and permanently watertight when the joints are subjected to the effects of repeated thermal movements, building movements, fluctuating wind forces, impact forces and the forces generated during transportation and handling.

8.8 Construction tolerances

Adequate allowances shall be made for all relevant construction tolerances associated with the building structure which will be concrete framed.

All structural fixing brackets shall be designed to provide adequate three way adjustments which does not rely on the use of an excessive thickness of packing shims, the combined maximum thickness of which shall not exceed 10mm.

8.9 Manufacture of frames

Joints in frames and sashes shall be made by mechanical means (cleating, screwing, etc) or by welding. Joints may have flush, stepped or lapped surfaces to approval. Mitred joints shall only have flush surfaces. The windows, doors, etc shall be free from all sharp edges, burrs and the like. Welded joints shall be cleaned off smooth on surfaces abutting closing faces, ie glazing rebates, etc. Hardware and fittings shall be removable without removing the aluminium frames from the structure. Sliding members shall be constructed so that no metal to metal sliding contact occurs.

Corners, joints and glazing beads are to be accurately mitred or notched and there must be no sharp edges or unsightly gaps when viewed from a distance of 3 metres under normal lighting conditions.

All corners and intersections vulnerable to water penetration should have adequate sealant applied to ensure weathertight installation.

8.10 Sealing of frames

The external perimeter of the frames is to be continuously sealed against the surrounding structure.

Weathersealing shall be of materials that are compatible with aluminium and shall be such that any degradation, shrinking, warping or adherence to sliding or closing surfaces does not impair the performance of the installation.

No contact of dissimilar metals is to be permitted. PVC or other approved separators are to be provided in all such conditions.

Glazing beads, gaskets and glazing compounds shall be of materials that are compatible with the aluminium, finishes, the glass and any other glazing materials.

Hardware, bearing devices and fittings in general must be made of materials resistant at atmospheric corrosion, and shall be of a design so as to be accessible for adjustment, repair and replacement after the windows etc have been installed.

Fastenings shall be of material which is compatible with aluminium and aluminium finishes.

8.11 Ancillary members

Ancillary members such as cills, flashings, infill panels and the like which may be formed from flat sheet material shall be made from an appropriate alloy selected from alloy designations – 1200 or 3004 or 5251, of a temper suitable for the method of forming, and a composition suitable for anodising or painting as required. Alloys shall comply with BS 1470.

8.12 Thermal movement

The design of all aluminium framing members shall take into account external surface temperature extremes in the range 10 degrees C to 80 degrees C and will permit any glazing panel to be partially shaded/partially exposed to sun, without any risk of cracking or damage to glazing due to thermal shock and temperature differentials.

Greater surface temperature extremes shall be allowed for should the contractor be of the opinion that it is necessary to do so in order to provide a problem-free installation which satisfied the minimum standard of performance specified therein.

Differences between these surface temperatures and the ambient temperatures at the time of fabrication and installation shall also be taken into account.

The design, fabrication and installation of the work shall be such that thermal and other movements and the effects of wind and air movements do not cause ‘cracking’, ‘rattling’, ‘whistling’ or any other noise.

8.13 Opening windows

All opening windows shall be gasket glazed units fabricated from extruded aluminium sections.
Opening windows other than central pivot windows, will be restricted to a maximum opening of 300mm. This restricter will be key openable to allow window cleaning where required.

The windows shall be fully weather-stripped. The weather-stripping shall take the form of compressible neoprene, EPDM or silicone gaskets extruded complete with integral projections designed to engage in grooves in the aluminium framing components.

The windows shall be capable of adjustment to achieve adequate and uniform compression of the weather-stripping.

The windows shall be fitted with:

i) Locking lever handles to all ground floor opening lights. Lever handles to upper floors.

ii) Sliding friction stays restricted to limit the open angle of the lower window to 300mm.

iii) Central pivotting hinges, reversible for cleaning.

iv) Permanent ventilation slots with mosquito gauze to Nairobi City Council, or similar, regulations.

All window ironmongery shall be finished in satin anodised aluminium.

8.14 Cleaning and hand-over

Prior to hand-over of any sections of the work, such sections inclusive of any adjacent areas dirtied by the contractor, shall be thoroughly cleaned by him.

The contractor shall remove any protective material and clean down and hand over reasonably sized sections of the work at such times as are mutually agreed upon between the contractor and his subcontractor, subject to approval. Provided further that the removal of protection and cleaning down and the subsequent hand over shall be done as soon as is possible.

8.15 Testing

One sample of each fully finished element shall be submitted to the Architect for testing for weathertightness. This is to be done in due time for detailed modification of the units and any retesting necessary, so as to allow for the whole of the work to be manufactured and installed in accordance with the contractors programme.

The test is to include for a procedure that will establish whether the system will produce any audible ‘whistling’ noises above 25 db, measured 2000 from the work, in winds of a velocity of more than 26 kph. Wind noise in excess of this is not acceptable.

8.17 Damaged work

All aluminium damaged prior to the date of hand-over of the work shall be timeously replaced at the cost of the contractor.

8.18 Protection of aluminium

All aluminium delivered to site shall be protected by tightly wrapping all members in plastic strip and/or by robust self-adhesive material, to approval.
PART 9 FINISHINGS

GENERAL

9.1 Other specifications

All other specifications of this contract where applicable are deemed to apply equally to the finishings specifications.

9.2 Samples

The Contractor shall prepare at his own cost sample areas of the paving, plastering and rendering 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.

9.3 Finished thicknesses

The thicknesses of floor finishes quoted in this section of the specification shall be the minimum requirements.

Suspended floors shall have a constant structural thickness and have level top surfaces. The finished floor surface will equally have a constant level and any adjustment needed to achieve this effect with the varying floor finish materials is to be made in the screeds beneath the same.

Slabs bearing on the ground may be cast to varying levels, and be of constant thickness with varying formation levels, or have varying thicknesses at the option of the Contractor. This stipulation in no way relieves the Contractor of the requirements of the specification for structural work.

9.4 Materials generally

All materials shall be of high quality, obtained from manufacturer's to be approved by the Architect.

Cement, sand and water shall be as described under Concrete Work and Blockwork.

9.5 Bonding

Bonding compounds, etc., for use in applying plaster and similar finishes direct to surfaces without the use of backings or screeds are only to be used if approved by the Architect and are to be used strictly in accordance with the manufacturer's printed instructions.

9.6 Chases, openings and holes

All chases, holes and the like which were not formed in the concrete or walling shall be cut, and all service pipes shall be fixed and all holes and chases filled with mortar before paving and plaster work is commenced. In no circumstances will the Contractor be permitted to cut chases, holes and the like in finished pavings or plasterwork.

INSITU FINISHINGS

9.7 Generally

The term plastering refers to the operation internally and rendering to the same operation externally but for ease of reference the term plastering has generally been used in this specification to describe both operations.

9.8 Mixes

The methods of measuring and mixing plaster shall be as laid down under Concrete Work and the proportions and minimum thickness of finished plaster shall be in accordance with the following:

<table>
<thead>
<tr>
<th>Item of Work</th>
<th>Mix</th>
<th>Thickness and Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Plaster</td>
<td>1 part cement 1/4 part lime 4 parts sand</td>
<td>12 mm finish to walls and ceilings steel trowelled unless otherwise specified</td>
</tr>
<tr>
<td>External Render</td>
<td>1 part cement 4 parts sand woodfloat</td>
<td>12 mm finish with finish unless otherwise specified</td>
</tr>
<tr>
<td>Tyrolean finish</td>
<td>Ditto</td>
<td>6 mm finished thickness in two coats on 10 mm plastered backing</td>
</tr>
</tbody>
</table>

To obtain greater plasticity a small quantity of lime may be added to the mixes for external plastering at the Architect's discretion but in any case this is not to exceed 1/4 part lime to 1 part cement.

With regard to the lime mortars gauged with cement, the addition just before use, of the cement to small quantities of the lime/sand mix shall preferably take place in a mechanical mixer and mixing shall continue for such time as will ensure uniform distribution of materials and uniform colour and consistency.

It is important to note that the quantity of water used shall be carefully controlled. Plaster may be mixed either in a mechanical mixing machine or by hand.

Hand mixed plaster shall first be mixed in the dry state being turned over at least three times. The required amount of water should then be added and the mix again turned over three times or until such time as the mass is uniform in colour and homogeneous.

The plaster shall be completely used within thirty minutes of mixing and hardened plaster shall not be remixed but removed from the site.

9.9 Preparation of surfaces for plaster etc.

Irregularities in the surfaces to be plastered or rendered shall be filled with mortar, without lime, twenty four hours before plastering is commenced. Joints in blockwork, etc., are to be well raked out before plastering to form a good key. Smooth concrete surfaces to be plastered shall be treated with an approved proprietary bonding agent or hacked to provide an adequate key for the plaster.

All surfaces to be plastered or rendered shall be clean and free from dust, loose mortar and all traces of salts.

All surfaces shall be thoroughly sprayed with water and all free water allowed to disappear before plaster is applied.

As far as practical, plastering shall not be commenced until all mechanical and electrical services, conduits, pipes and fixtures have been installed.

Before plastering is commenced all junctions between differing materials shall be reinforced. This shall apply where walls join columns and beams, particularly where flush, and similar situations where cracks are likely to develop and as directed by the Architect. The reinforcement shall consist of a strip of galvanised wire mesh 'Expamet' or equal approved 15 cm wide which shall be plugged, nailed or stapled as required at intervals not exceeding 45 mm at both edges. The surfaces to which such mesh shall be applied shall be painted with one coat bituminous paint prior to fixing the mesh.

9.10 Application of plaster and render

After preparation of the surfaces a key coat of
cement slurry shall be applied to the wetted surface to be plastered. When this coat is dry the plaster coat shall be applied, by means of a trowel, between screeds laid, ruled and plumbed as necessary. This coat which shall be to the required thickness shall be allowed to se hard and then cured as described. Surfaces are to be finished with a wood or steel float to a smooth flat surface free from all marks.

All plastering and rendering shall be executed in a neat workmanlike manner. All faces except circular work shall be true and flat and angles shall be straight and level or plum. Plastering shall be neatly made good around pipes or fittings. Angles shall be rounded to 6 mm radius.

All tools, implements, vessels and surfaces shall be at all times kept scrupulously clean and strict precautions shall be taken to prevent the plaster or other materials from being contaminated by pieces of partially set material which would tend to retard or accelerate the setting time.

9.11 Curing of plaster

Each coat of plaster is to be maintained in a moist condition for at least three days after it has developed enough strength not to be damaged by water.

9.12 Angle beads

Where required by the Architect, salient external angles of plastered walls shall be protected with galvanized mild steel angle beads complying with BS 1246 Fig. 7 Profile C3.

They shall be securely plugged, nailed or stapled as required at intervals not exceeding 450 mm at both edges.

9.13 Plaster stops

Where shown on details, plasterwork shall be stopped against “Expamet” galvanized steel plaster stop, reference S5S which shall be securely nailed to walls in the positions indicated on the drawings.

9.14 Textured decorative plaster finishes

Textured decorative plaster finishes shall be a pre-mixed textured finish as manufactured by Conmix Ltd, P.O. Box 5936, Sharjah, UAE email conplast@conmix.com and obtained through The Building Centre, P.O. Box 56597, Nairobi or equal approved.

The finishes shall be applied by trowel or roller as stipulated by the manufacturer for the particular finish as specified in the bills of quantities.

The finishes shall be applied strictly in accordance with the manufacturers instructions and to the approval of the Architect. Finished thicknesses shall be in accordance with the manufacturers recommendations.

Finish Type SP2 is to be applied to external walls and finish Type SP3 is to be applied to internal piers and columns and external verandah columns.

9.15 Cement and sand screeds

Screeds shall be mixed and formed as described.

9.16 Terrazzo and granolithic work

The whole of the terrazzo and granolithic work is to be carried out by a specialist sub-contractor who is to be specifically approved by the Architect and the contractor will be required to make arrangements for the execution of this work and bear all expenses incurred.

The materials used and method of construction for terrazzo work are to be in accordance with the BS Code of Practice CP 204/1951.

The surface finish to terrazzo is to be polished to comply with samples approved by the Architect.

The terrazzo topping is to be 20mm thick with imported white cement and 12mm marble aggregate, rolled and trowelled to a dense even surface and rubbed down at completion to a grit finished surface free from holes and blennishes.

Terrazzo features for capitals and bases will be either pre-cast or in-situ with the approval of the Architect. Colours shall be as selected by the Architect.

The paving is to be laid in squares divided by divided strips anchored securely in the screed and having their top edges truly level with the finished floor surface. The terrazzo work is to be laid and finished complete to the approval of the Architect.

The granolithic topping is to be 15mm thick and shall consist of one part coloured cement to two parts aggregate to 6mm gauge mixed with 15% fine dust. Aggregate is to be 70% black trap and remainder approved local coloured stone. Colours shall be as selected by the Architect. Paving is to be rolled and trowelled to a dense even surface and rubbed down at completion to a grit surface free from holes and blennishes. The paving is to be laid in squares divided by plastic strips anchored securely in the screed and having their top edges level with the finished floor surface.

The granolithic work is to be laid and polished complete to the approval of the Architect. The screed between the granolithic topping and the concrete floor is to be cement and sand (1:3)

The contractor is to twice scrub the topping with soap and water before twice wax polishing and handing over.

9.17 Dividing strips

Dividing strips shall be 3mm thick plastic and of a similar height as the paving in which they are embedded. Strips shall be cut to lengths and embedded in the pavings to form margins or bays to a detailed pattern or between differing floor finishes.

Dividing strips are to be cut as required to ensure a flush level surface with the paving.

9.18 Non-slip polished pavings

Where pavings are described as non-slip they shall have carborundum dust sprinkled evenly over the surface at the rate of one kilogram per square metre lightly trowelled in whilst still green.

9.19 Surface hardeners

Floor hardeners shall comprise an approved type guaranteed by the makers to produce a hard dense concrete with high abrasive resistance, impervious to the penetration of heavy oils, acid or alkali solutions and to be used strictly in accordance with the maker’s instructions.

The first dressing of sodium silicate for granolithic flooring shall be one part of sodium silicate to six parts of water by volume.

Subsequent dressing shall be composed of one part of sodium silicate to four parts of water by volume, for all surfaces. The two liquids shall be well mixed together, sprayed over the flooring and spread evenly with a mop or soft brush, any excess being wiped off and the flooring allowed to dry for at least 24 hours after each dressing. After final drying, floors shall be washed with clean water.

9.20 Rates of in-situ work
The rates for in-situ work shall include for raking out joints of blockwork or bonding coat or spraying cement slurry on new concrete surfaces to form key, for work in narrow widths, small and isolated areas, rounded arrises, fair and chamfered edges, for making good and working around pipes, brackets etc., and for all other incidental labours.

Rates shall also include for masking before the application of spray finishes work executed overhead, temporary rules, supports, screeds and templates.

**TILES, SLAB AND BLOCK FINISHINGS**

**9.21 PVC Vinyl floor tiles**

PVC vinyl floor tiles shall be imported as Marleyflex or other equal approved manufacturer.

PVC vinyl floor tiles shall be 2.5mm thick and comply with B.S. 3260 of an approved manufacturer to patterns as directed by the Architect. Adhesives are to be as recommended by the manufacturer in writing and approved by the Architect. Bitumen is not an approved adhesive.

The tiles are to be laid and bedded direct in adhesive on to a cement and sand bed to make up the total paving thickness.

The cement and sand screed is to be finished with a steel trowel to a perfectly smooth surface before the application of the mastic and tiling.

On completion the PVC vinyl tiles are to be sealed and polished with wax all in accordance with the manufacturer’s printed instructions.

Adhesives are to be polychloroprene as approved by the manufacturer and the Architect.

**9.22 Clay tile paving**

Clay tile pavings are to be in 200 mm x 200 mm tiles obtained from an approved manufacturer, and are to be laid on prepared screeds. The tiles are to be bedded in cement and sand (1:4) with straight joints in each direction. Upon completion grout in cement and wash and clean down. Tiles are to be cut with an electric tile cutting saw.

Finish to clay tiles to be three coats Transeal by Sadolin Ltd applied strictly in accordance with the manufacturers instructions.

**9.23 Ceramic wall and floor tiles**

The ceramic wall and floor tiles shall be from an approved manufacturer, and shall conform with the requirements of BS 1281. Tiles shall be of standard quality of the colours specified or approved. Tiles shall be laid with continuous straight joints and internal angles shall be butt jointed. Rounded on edge tiles shall be used at all external angles and at edges of panels. Cut tiles will be used in internal corners, full tiles in external corners.

Maximum joint size is 3mm when grouted. Movement joints are to be at maximum 6m centres

Skirtings are to be formed in matching tiles, fixed with tile adhesive

300 x 300 special ribbed tread nosing tiles are to be utilised on all stair treads.

Tiles shall be well soaked in water, bedded in approved proprietary tile adhesive, pointed in an imported proprietary coloured grouting material, and cleaned and polished on completion.

**9.24 Granite and marble tiling**

Marble Tiling

20mm polished marble tiling in colours and sizes approved by the Architect. All tiles shall be carefully chosen for consistency in colour, size and texture.

Tiles to be bedded in sand cement bedding, and to be laid level with other adjacent finishes

Granite Vanity Tops

Vanity tops to be formed in 600 x 400 x 20mm thick polished granite tiles, bedded in mortar on concrete vanity substrata. Edging tile to front edge to have rounded nosing, with vertical fascia panel, fixed with ‘Latcrete’ or equal and approved bonding agent.

**9.24 PVC bead protection to wall tiling**

PVC corner and edge beads to the Architects approval are to be provided to external corners and edges of ceramic wall tiles.

**9.25 Expansion joint covers**

Expansion joint covers are to be a proprietary imported stainless steel sliding cover with PVC infill strips fixed on both sides of structured movement joints. The contractor shall provide samples for the Architects approval.

**9.26 Precast concrete paving slabs**

To be all in accordance with B.S. 368. The slabs are to be of the sizes given herein and bedded, jointed and pointed in cement lime mortar (1:2:9).

**9.27 Rates**

The rates for tile, slab and block finishes shall include for rounded edge tiles and angles, cutting and fitting up to boundaries and around pipes, brackets, etc., and waste; for work in narrow widths, small and isolated areas and for all other incidental labours.

**SUSPENDED CEILINGS**

**9.28 Generally**

The Contractor shall provide shop drawings to show the final layout and sizes of members of all suspension systems and to co-ordinate the design and work of suspended ceilings with other trades to provide for the reception and installation of outlets, fixtures etc., pertaining to mechanical or electrical work, all for the Architect’s approval before any work is commenced.

Ceilings shall be erected by workmen skilled in this work in a rigid and secure manner so that the final surface is free from any waves, buckles or sags.

**9.29 Acoustic ceilings**

Acoustic tile ceilings shall be 600 x 600 x 15 mineral fibre tiles, fine fissured finish, with regular edge in shops and WC’s with exposed powder coated suspended aluminium 24mm T frame grid system. All ceilings to have shadow gap trim to junction with wall, and to be set out with full tile at centre line in both directions of room or space ceiling installation. Manufacturer to be Armstrong or approved alternative, and to be installed entirely in accordance with the manufacturer’s instructions, incorporating all fittings and accessories, including suspension cable wires and hanger system.

The ceilings shall include a proprietary suspension system as recommended by the manufacturer. The suspension system shall be suspended from wire hangers fixed to concrete soffit and steel roof structures by an approved method. All to be fixed strictly in accordance with the manufacturers instructions.
9.30 Gypsum Plasterboard Ceilings

Plasterboard for ceilings to comply with the requirements of BS1230 Part I and to be manufactured under BS 750 Part 2 12.7mm thick. Fixing, installation and filling of joints to be strictly in accordance with manufacturers instructions. Plasterboard to have tapered edge, with taped and filled joints, finished in accordance with the manufacturers instructions.

The joints between boards shall be provided with a fine metal or plastic scrim tape, nailed or stapled to the boards so as to fully cover the joints and ready for a plaster skim.

Gypsum plaster skim coat

All joints between boards and blemishes in boards are to be skimmed with a fine proprietary gypsum plaster specially manufactured for that purpose. A gypsum plaster skim coat is to be applied to the whole surface of the gypsum plasterboard in accordance with the manufacturers instructions and to the approval of the Architect.

Plasterboard is to be fixed to a proprietary pressed metal brandering system to Architects approval.

9.31 Expanded metal lathing ceilings

Framework for expanded metal lath ceilings shall be as specified. Straps shall be bolted either to steelwork or to steel angle cleats raw bolted to concrete soffit.

Covering shall be galvanized expanded metal lathing Ref. 264 fixed to underside of suspension grid with 16 gauge soft galvanized tying wire or to underside of timber framing at maximum 356mm centres.

The whole to form a suspension grid ready and of adequate strength to receive plaster or other applied finish and with supports for lighting fittings where required.

The Contractor shall submit to the Architect for approval prior to erection, shop drawings showing the precise layout of suspended ceiling systems.

9.32 Rates for suspended ceilings

Rates shall include for shop drawings as specified; all hangers and supports as required including fixing same to concrete or ductwork; for angles at edges, for corner angles at upstands, for cutting and fitting around grilles and registers and light fixtures and for leaving in a perfect condition to the entire satisfaction of the Architect.

Rates shall also be deemed to include the use of plaster stops and angle beads around the edges and at all corners.

Rates shall include for all edge details, angle runners and light fitting frames as required.
**PART 10 GLAZING**

**MATERIALS**

10.1 General

Glass used in glazing and for mirrors shall be best quality clear glass free from visible defects so as to afford uninterrupted vision or reflection as appropriate, and without obvious distortion.

10.2 Standards

Glass for glazing and mirrors shall be of approved manufacture and is to comply with B.S. 952 in all respects free from flaws, bubbles, specks and other imperfections.

10.3 Clear sheet glass etc.

The clear sheet float glass shall be ordinary glazing (OG) quality.

10.4 Plate glass

Polished plate and Georgian wired polished plate glass to be selected glazing (SG) quality.

10.5 Obscured glass

To be of type described and as approved by the Architect.

10.6 Solar glass

Solar control glass is to be obtained from a manufacturer approved by the Architect. Details of the characteristic and properties of the glass are to be provided to the Architect before ordering.

Solar glass is to be the spectralfloat type incorporating metallic irons in the glass with a bronze tinted colour. Unless otherwise specified thickness of glass is to be 6mm.

10.7 Laminated glass

The contractor shall provide details of the specification and manufacturers of laminated glass for the Architect’s approval before ordering.

Laminated glass in this specification is referenced to the South African Bureau of Standards (SABS)

Laminated glass is to be installed in accordance with:

a) The recommendations of the glass manufacturer

b) SABS Code of Practice 0137 and SABS 1263

All safety glass is to be clearly marked by means of either sandblasting, acid-etching or the application of transparent labels in accordance with the requirements of SABS 1263.


The marking is to be to the minimum SABS marking requirement and is to state the type of materials i.e. laminated glass, toughened glass, polycarbonate, etc.

All glass is to be cleaned prior to inspection. Scratches in glass which are acceptable, are those which are less than 75mm long in any area, and those which are longer than 75mm which do not encroach more than 75mm from the exposed visible edge.

No interlayer bubbles will be accepted in the laminated glass.

10.8 Glazing method for laminated glass

There is to be no glass to metal contact.

All opening sections shall be fitted with vinyl or other approved weather strips and draught excluders.

Fittings are to be fitted to the frame with stainless steel set screws. The riveting of screws or brackets will not be accepted.

The bit on the glazing material in the rebate is to be sufficient to meet the requirements of the application, and no edges of the glazing material may be visible.

No excess sealant or spillage shall be visible when viewed from a distance of three metres.

Sealants used are to have no gaps or air pockets and are to be visible on both sides of the glass when bead glazed. Where translucent structural silicone sealant is used without glazing beads, small air bubbles are accepted provided these are not at the exposed surfaces.

Gaskets are to be continuous and not loose or unsightly at corners. If mitred corners are used, only corner joints are permissible.

10.9 Glazing gaskets

Glazing to metal frames shall be secured with clip-in gasket of butyl rubber. The gaskets shall be of size and section to suit the frame and glazing so as to provide a weather and air tight seal. The mechanical properties of the gasket shall be such as to resist the climatic conditions experienced in Kenya.

10.10 Washleather

Washleather shall be best quality chamois oil cured natural coloured. Where washleather is called for an approved substitute may be employed.

10.11 Putty

(a) The putty for glazing to wood sashes is to be linseed oil putty all as B.S. 544.

(b) The putty for glazing to metal windows is to be gold size metal window putty specially designed for tropical use, or patent mastic putty if approved by the Architect.

10.12 Mirrors

Mirrors shall be polished float glass silver in quality with baulved edges protected at back with electro-copper backing coated with Shellac varnish and paint. The mirrors are to be fixed with chromium plated dome headed mirror screws with plastic or rubber distance pieces and washers unless otherwise stated and rates shall include for this.

**WORKMANSHIP**

10.13 General

Glazing of all types and in all locations shall be carefully executed by artisans skilled in this type of work and in conformance with the recommendations of C.P. 152. Glazing shall be carefully fitted so that is is not subject to pressure and stresses imposed by being an overtight fit within the framing.

10.14 Measurements

Each element (door, window, etc.) to receive glass shall be accurately measured to ensure a
perfect fit subsequently.

10.15 Single glazing

Single glazing shall be executed with glass of the various types described herein. Ordinary (non-safety) glass may be pre-cut or cut on site.

10.16 Wired glass

Wired glass shall be cut so that the wires embedded are truly vertical and horizontal (i.e. at right angles to the cut edges).

10.17 Laminated glass

Laminated glass shall be factory cut before delivery to site. Site cutting will not be permitted.

10.18 Storage and handling

Glass shall be delivered to site in stout containers and clearly marked. The containers shall incorporate sling attachment points for lifting briddles. Glass shall be stored under cover so that the panes are truly vertical.

10.19 Protection

After fixing glass shall be boldly marked with paper or whitewash so that it is clearly visible. In positions where damage due to construction traffic or activity is likely to occur stout screens composed of hardboard or fibreboard on battens shall be arranged to protect the glass.

10.20 Damage

Should any glass delivered to site be found to be damaged it shall not be incorported into the works without the express permission of the Architect. Should glazing installed be damaged for any reason it shall be removed and replaced free of charge to the satisfaction of the Architect. Should any adjacent works be damaged this shall equally be reinstated free of charge to the satisfaction of the Architect.

10.21 Defective work

All glass shall be checked before installation to ensure that defective glass is not installed. Notwithstanding this, if in the opinion of the Architect, any installed glazing is defective it shall be removed and replaced free of charge to the satisfaction of the Architect.

10.22 Glazing to wood

Glazing shall be secured to wood framing with hardwood beads. Edges shall be wrapped in washleather so that the washleather finishes just below the surface of the bead. No adhesives shall be used.

10.23 Glazing to metal

Glazing shall be secured to metal framing with clip in butyl rubber gaskets.

10.24 Glass thickness

Glass thickness shall conform to the recommendations of C.P. 152 and the manufacturer’s recommendations for sizes of panes relative to the position in the building and the effects of wind pressure (both negative and positive).

10.25 Cleaning

All windows glazed panels and mirrors shall be cleaned both inside and out immediately prior to the handing over of the building to the satisfaction of the Architect.

SPECIFICATIONS
11.1 Materials

11.1.1 Manufacturers

Except where stated all materials shall be obtained from approved manufacturers. The Contractor shall state the name and address of the manufacturer whose materials he proposes to use. Once approval has been given the Contractor shall not obtain materials from other sources without the prior written agreement of the Architect.

Painting products shall be obtained from one of the following approved manufacturers:

a) Crown Paints
b) Basco Paints
c) Sadolin paints
d) Dulux Paints

All paint shall be grade A quality.

11.2 General

Each succeeding coat of priming, undercoating and finishing (pigment) or clear coating shall be sufficiently different in colour as to be readily distinguishable.

All primers and paints in one system upon a particular surface shall be obtained from the same manufacturer.

The mixing of paints, etc., of difference brands before or during application will not be permitted.

11.3 Emulsion paints

Emulsion paints shall be matt or satin finish vinyl emulsion paint. Silk vinyl finish shall be used where specified.

The first (mist) coat shall be thinned in accordance with the manufacturer’s instructions.

11.4 Gloss paint

Gloss paint shall be hard gloss finish oil paint.

11.5 Blucheuring paint

Blucheuring paint for door handles and gutters is to achieve a wrot iron effect to be obtained from Sadolin paints or equal approved.

11.6 Automotive paint

Automotive paint is to be two pack epoxy paint on specified surfaces factory applied, with baked finish, by Sadolin or other approved manufacturer. Colour selection is to be to the Architect’s approval.

11.7 Bituminous solution

Bituminous solution for use on coated pipes, RC and blockwork faces beneath ground level shall be obtained from a manufacturer approved by the Architect.

11.8 Traffic paint

To be as Crown Paints, Road Paint or other approved for use on concrete block paving.

11.9 Lead based paints

The use of lead based paints will not be permitted.

11.10 Clear finishes

Clear finishes internally shall be clear polyurethane varnish one or two pack as specified.

11.11 Varnish

Varnish is to be an imported water based varnish/stain by Sadolin or other equal approved.

11.12 Primers and undercoats

Unless otherwise specified, primers and undercoats shall be the type recommended by the manufacturer of the finishing coats specified for a particular surface. Primer for external bare metalwork surfaces shall comply with B.S. 2523.

11.13 Knotting

Shellac knotting shall comply with B.S. 1336.

11.14 White spirit

The white shall comply with B.S. 245.

11.15 Timber stain

Timber stain shall be oil based pigmented stain. The application of this material shall be strictly in accordance with the manufacturers written instructions. Tin and degree of application shall be to the order of the Architect.

11.16 Textured coating

Textured coating is to be of proprietary manufacture approved by the Architect of an approved colour.

Technical information concerning the coating is to be submitted to the Architect before ordering, but the minimum qualities of the coating are to be as follows:-

(a) Suitable for application internally and externally to plastered, rendered, concrete, block, stone, brick, asbestos and timber surfaces.

(b) Minimum durability of 10 years even in exposed conditions.

(c) Maintenance free.

(d) Built-in mould resistant fungicide.

11.17 Stopping

The stopping shall be as follows:-

(a) Plasterwork shall be plaster based filler.

(b) Concrete and brickwork shall be similar material to the background and finished in a similar texture.

(c) Internal woodwork, plywood and blockboard shall be putty complying with B.S. 544.

(d) External woodwork shall be white lead paste complying with B.S. 2029.

(e) Internal clear wood finishes: the stopping shall be that recommended by the clear lacquer manufacturer.

11.18 Fillers

The fillers for internal joinery shall be the type recommended by the paint manufacturer for use with his type of paint or lacquer.

Stopper and fillers shall be tinted to match the undercoat, and shall be compatible with both undercoats and primers.

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

WORKMANSHIP

11.19 General

Workmanship generally shall be carried out in accordance with B.S. C.P. 231, unless otherwise specified.
Before painting is commenced floors shall be swept and washed over; surfaces to be painted shall be cleaned before applying paint as specified, and all precautions taken to keep down dust whilst work is in progress.

No paint shall be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation, efflorescence, etc., before the application of each coat.

No painting shall be carried out externally during humid, rainy, damp or freezing conditions, or conditions where surfaces have attained excessively high temperatures or during dust storms.

No new, primed or undercoated woodwork and metalwork shall be left in an exposed unsuitable situation for an undue period before completing the process.

No dilution of paint materials shall be allowed except strictly as detailed by the manufacturer's own direction, either on the containers, or their literature, and with the special permission of the Architect. For external work dilution of paints will not be allowed whatsoever. For internal work, where permitted by the Architect, undercoats may be thinned by the addition of not more than 5% thinners. Gloss finish shall not be thinned at all.

Metal fittings such as ironmongery etc., not required to be painted shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed the fittings shall be cleaned as necessary and refixed in position.

11.20 Brushwork

Unless otherwise specified, all primers and paints shall be brush applied. Written permission must be obtained from the Architect's if an alternative method of application is to be used.

11.21 Stopping and filling

Unless otherwise specified by the manufacturer all primers and undercoats shall be stopped flush and rubbed down to a smooth surface with an abrasive paper and all dust removed before each succeeding coat is applied. Care shall be taken to prevent burnishing of the surface.

11.22 Stirring

Unless otherwise specified by the paint manufacturer all paint materials shall be thoroughly mixed and/or stirred before and during use, and suitably strained as and when necessary.

11.23 Inspection

No priming coats shall be applied until the surfaces have been inspected and the preparatory work has been approved by the Architect. No undercoats or finishing coats shall be applied until the previous coat has been similarly inspected and approved.

11.24 Paint application

Each coat of paint shall be so applied as to produce a film of uniform thickness. All paint shall be applied in accordance with the manufacturer's instructions. Special attention shall be given to ensure that all surfaces including edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of adjacent painted surfaces.

11.25 Drying

All coats shall be thoroughly dried before succeeding coats are applied. Allow a minimum of 24 hours between application on any one surface, unless otherwise specified by the manufacturer.

11.26 Unprimed woodwork

Unprimed woodwork scheduled to be painted shall be rubbed down with abrasive paper and dusted off. Care shall be taken to prevent 'burnishing' of the surface. All knots and resinous areas shall be coated with two coats of knotting. Pitch on large, open unseasoned knots and all other beads or streaks of pitch shall be scraped off, or if still soft, shall be removed with white spirit before applying the knotting. Apply one coat of priming to all surface, two coats to all end grain, to be subsequently painted. Backs of all wood frames in contact with concrete, brickwork, blockwork and metalwork or similar materials shall be primed before fixing. After priming all joints, holes, cracks shall be stopped and filled, rubbed down and dusted off.

11.27 Primed woodwork

Woodwork delivered primed shall be lightly rubbed down with abrasive paper, and dusted off. Touch up bare areas with a similar priming including open grained ends. After touch priming all joints, holes, cracks and open grained ends shall be stopped and filled, rubbed down and dusted off.

SPECIFICATIONS PAINTING & DECORATING

11.28 Plywood and blockboard

Edges of exterior plywood and blockboard shall be sealed with two coats of aluminium primer and the backs treated with a lead primer.

11.29 Clear finished woodwork

All woodwork scheduled to receive a clear finish shall be well sanded with the grain removing all dirt etc., to give as smooth a surface as possible. Resinous timber shall be swabbed down with white spirit and dried thoroughly. Split or end grain shall be filled with suitable filler recommended by the clear lacquer manufacturer, in accordance with their instructions, and of the appropriate shade.

11.30 Bare metalwork

Bare metalwork shall be thoroughly cleaned off all dirt, grease, rust and scale by means of chipping, scraping and wire brushing; particular attention should be given to the cleaning of welded, brazed and soldered joints. Wash down with white spirit and wipe dry with clean rags. Apply a coat of metal primer immediately the cleaned surfaces have been approved by the Architect.

11.31 Galvanized metalwork

Galvanized metalwork scheduled for painting shall be thoroughly cleaned off all dirt, grease, dusted and washed down with white spirit and wiped dry with clean rags. Any minor areas of rust shall be removed by wire brushing and spot primed with a zinc rich primer. Apply at least one coat of calcium phosphate primer to all surfaces subsequently to be painted.

11.32 Primed metalwork

If the priming coat of pre-primed metalwork has suffered damage in transit, or during erection on site, the affected areas shall be cleaned off by wire brushing, abrading and dusting off, the bare patches touched up with a primer of a similar type to that already applied.

11.33 Copper

Copper scheduled for painting shall be lightly abraded with emery cloth, washed with white spirit and wiped dry with clean rags. Apply a coat of etch primer immediately the cleaned surfaces have been approved.
11.34 Brickwork, concrete etc.

All brickwork, blockwork, concrete, rendered and plaster surfaces scheduled to be painted shall be brushed down, all holes and cracks filled, all projections such as plaster, or mortar splashes etc., removed to leave a suitable dust free surface. All traces of mould oil shall be removed from concrete surfaces by scrubbing with water, detergent and rinsing with clean water. All these surfaces shall be thoroughly dry before any primer or pains are applied. Apply a coat of alkali resisting primer where surfaces are to be finished with oil paints or alkyl resin type emulsion.

Asbestos cement surfaces scheduled for painting shall be brushed down to remove powdery deposits, and a coat of alkali resisting primer applied where such surfaces are to be finished with oil paints or alkyl resin type emulsion.

11.35 Colours

The colours will be selected by the Architect from the paint manufacturer’s standard colour range.

11.36 Toxic wash

Concrete, blockwork, plaster and timber surfaces which are to be painted shall be washed down prior to painting with a toxic wash applied by brush or spray. A second wash shall be applied two days after the first wash. The surfaces shall be then allowed to dry out completely before application of paint.

11.37 Protection

Proper care must be taken to protect surfaces while still wet by using of screens and ‘wet paint’ signs where necessary.

11.38 Damage

Care must be taken when preparing surfaces, or painting etc., not to stain or damage other work. Dust sheets and covers to the satisfaction of the Architect shall be used to protect adjacent work. Any such stains or damage shall be removed and made good at the Contractor’s expense.

11.39 Cleanliness

All brushes, tools, pails, kettles and equipment shall be clean and free from foreign matter. They shall be thoroughly cleaned after use and before being used for different colours, types or classes of material. Painting shall not be carried out in the vicinity of other operations that may cause dust. Waste liquids, oil soaked rag, etc., shall be removed from the building each day. Waste liquids shall not be thrown down in any sanitary fittings or drains.

11.40 Performance

If, while the work is in progress, the paint appears to be faulty, such as consistency of colour, drying time, or quality of finish, the work shall be stopped at once and the manufacturer consulted.

The manufacturer’s of the materials shall be given every facility for inspecting the work during progress in order to ascertain that the materials are being used in accordance to their directions, and to take samples of their products from the site if they so desire for tests.

The finishing coats of the various paints or surface finishings shall be free from sags, brush marks, runs, wrinkling, dust, bare or ‘starved’ patches, variations in colour and texture, and other blemishes.

When the work has been completed, the finished surfaces shall not be inferior in quality, colour and finish to the samples approved by the Architect, and imperfections in manufacture shall not be apparent through these finished surfaces.

In the event that the Architect is not satisfied that the quality of finish does not comply with the required standards and/or the sample panel the Contractor will be required to repaint at his own expense, such work to the satisfaction of the Architect. If in the opinion of the Architect it is necessary to remove completely the unsatisfactory paintwork this shall also be done under the direction of the Architect at the expense of the Contractor.

11.41 Packaging, delivery and storage

All paints and surface coatings shall be delivered in sound sealed containers, labelled clearly by the manufacturers, the label or decorated container must state the following:-

(a) The type of product.
(b) The brand name and colour
(c) The use for which it is intend
(d) The manufacturer’s batch number
(e) The B.S. number if applicable
(f) All labels shall be printed - containers bearing type written labels will not be acceptable.

SPECIFICATIONS PAINTING & DECORATING

Materials shall be stored under cover in accordance with the manufacturer’s instructions, and with local fire and safety regulations. The store itself must be maintained at a temperature of not less than 50 degrees F (10 degrees C) and must not be subjected to extreme changes of temperature.

The batch deliveries are to be dated and used strictly in order of delivery.

11.42 Vinyl emulsion paint

Surfaces to be painted shall receive one mist coat followed by two full coats of vinyl emulsion paint. Application may be by means of rollers or brushes.

11.43 Gloss finish paint

Surfaces to be painted shall be primed then painted with two undercoats followed by one coat gloss finish paint.

11.44 Clear polyurethane varnish

Surfaces to be clear varnished shall be treated with two coats water based as Sadolins (UK) Ltd or equal approved.

11.44 Textured Coating

The manufacturer’s instructions concerning application of the coating are to be strictly followed under the direction of the Architect.

All surfaces to receive textured coatings are to be clean and dry with surfaces scraped and brushed before application of the coating.

Application of the coating is to be with textured roller or fibre brush as directed by the Architect with a minimum spreading capacity of 1 kilogramme per square metre. Under no circumstances is the coating to be thinned.

SPECIFICATIONS
PART 12 LANDSCAPING

12.1 Related documents

Drawings and general provisions of the Contract, including other sections of the bills of quantities and specifications, apply to work of this section.

12.2 Description of work

The term “landscaping” covers all soil preparation for planting work and all planting of trees, shrubs, grass and other plant materials. Landscaping works shall only be undertaken by a qualified landscape contractor or specialist to the approval of the Consultant.

The contractor will be required to produce a programme, available for inspection by the landscape consultant, of his expected operation from the date of arrival on site until the date of practical completion, within 14 days of appointment.

12.3 Product handling

All plant material is to be supplied to site by the contractor and maintained on site until such time as the site is handed over to the Client. The contractor is to be responsible for all ordering, inspections, and handling procedures and expenses which may be incurred through supply of plant materials.

12.4 Job conditions

a) Prior to excavation of the planting areas and planting pits the contractor shall ascertain the location of all utility lines, electric cables and conduits so that proper precautions may be taken not to disturb these, both above and below ground level. Any damage caused by the contractor shall be rectified at his own expense.

b) Existing vegetation: No existing trees or shrubs shall be removed, cut, or pruned, without specific written instructions from the Consultant.

c) Storage of Materials and Working Areas: Within a tree’s “dripline” the lighting of fires, erection of temporary building, the temporary or permanent storage of building materials of any description, the preparation of any building materials, (such as stone dressing, or carpentry workings), or any other activity which may also be deemed detrimental to the health and vigour of the trees by the Consultant shall be expressly forbidden.

d) Cutting and Pruning: Branches larger than 50mm in diameter may not be removed from any tree without the approval or instructions of the Consultant. Roots larger than 50mm diameter uncovered during the course of excavation may not be cut without the approval of the Consultant.

e) Excavation: Where the drawings necessitate work to be carried out beneath existing trees, all care must be exercised during excavation. Hand tools are to be used whenever roots are encountered.

f) Felling: Only those trees as directed by the Consultant may be removed. All other large trees, small trees, shrubs and hedges are to be retained and protected.

g) Plant Storage: Prior to plant material being delivered to the site, the Contractor must construct a shade house for storage of the plants until planting. The shade house is to be constructed with a flat roof covering of split bamboo poles (or approved equal) to allow filtered light through to the plant material to be stored below. The sides of the shade house are to be similarly constructed of split bamboo poles (or approved equal) to protect the plant material from intense solar radiation.

h) Planting of Plant Material: Plant material which has been supplied to the site “bare-rooted” must be immediately planted into heavy-duty polythene plant bags in good quality top soil approved by the Consultant. This is to be done under the constant supervision of the contractor. The plants are then to be stored in the shade house until they have fully recovered from transplantation prior to planting on site.

i) The contractor is to provide all plants as specified, all red forest topsoil for planting areas, dry well-rooted manure, bone meal and fertilizers as required.

PRODUCTS

12.5 Acceptable products

All plant materials must be obtained from reputable suppliers. The Contractor must supply a list of his intend suppliers to the Consultant for approval prior to ordering.

12.6 Plant materials

Substitutions

No substitutions shall be accepted, except with the written permission of the Consultant.

Quality

a) All plants shall have normal, well developed branches and vigorous root systems. They shall be sound, healthy, vigorous, free from defects, disfiguring knobs, abrasions of the bark, sunscald injuries, plant diseases, insect eggs, borers and all other forms of infections.

b) All plants shall conform to the measurements and requirements in the plant list and measurements specified shall be the minimum acceptable size for each species.

c) All shrubs and trees shall be container grown.

d) Plants must be well established in order that on removal, the root ball remains intact throughout the planting operation.

a) Broad leaved trees are to be supplied to site in a healthy condition, with a well developed root ball and crown with a clear, strong central leader with a minimum height of between 2.10 and 2.50 m and a clear stem free from side branches to a height of between 1.50 to 1.80m from ground level and to the Consultant’s approval.

Such trees are to be planted as described below and as shown in detail drawings.

b) Palms are to be supplied to site in a healthy condition with well developed root ball and a clear strong central leader, to a minimum height of between 1.00 and 1.5m and to the Consultant’s approval.

c) Deciduous trees shall have straight bodies according to their habit and growth and shall be well branched and rooted.

d) Evergreens shall be well branched and have ample well balanced root systems capable of sustaining vigorous growth.

Nursery stock

a) Deciduous shade trees shall be straight and symmetrical with crown having a persistent main leader preferred. The amount of crown shall be in good overall proportion to the total height of the tree. Where a clump is specified, a plant having a minimum of 2 stems originating from a common base at ground level shall be furnished.

b) Evergreen trees of all sizes will be in pots or
SPECIFICATIONS

Plant size

a) Plant larger than specified in the plant list may be used if approved by the landscape consultant, but use of such plants shall not increase the contract price. If the use of the larger plants is approved the spread of the roots or ball of earth shall be increased in proportion to the size of the plants.

b) Upto 10% of under-size plants in any one variety of grade may be used, provided that there are sufficient plants above size to make the average equal to or above specified grade.

Plant allowance

Plants shall be selected by the landscape consultant.

Preparation of plants

a) All plants shall be dug immediately before moving unless otherwise stated. In preparing plants for moving, all precautions customary in good trade practice shall be taken.

b) All necessary pruning shall be done at the time of planting.

c) Fresh young growing tips of Kikuyu grass are to be used for all grass areas unless otherwise specified. The tips must average 150mm in length and be approved by the landscape consultant.

Inspection

a) No plant material shall be planted until it is inspected and approved by the landscape consultant or his representative at the site of the project. They shall be the sole judge of the materials.

b) All plants shall be inspected for approval for variety, size and health, but approval from this inspection shall not preclude rejection of plants for defects which may appear later during the progress of the works.

c) All rejected material shall be immediately removed from the site and replaced with acceptable material at no additional cost.

Delivery

a) All plants shall be packed, transported and handled with utmost care to ensure adequate protection against injury.

b) The contractor shall ensure that adequate protection is given to all plants and their root systems to preclude failure due to lack of moisture or exposure during transport to the site.

c) Where plants cannot be planted immediately upon arrival they shall be stored in the site nursery until required.

d) All plants shall be tagged with plastic labels when delivered to the site with the full Latin botanical name clearly printed thereon in indelible ink. Labels shall be removed after planting with the approval of the landscape consultant.

Staking

Broad leaved trees shall be staked and tied in accordance with the detail drawings and to the Consultant's approval.

12.7 Supervision

The Contractor must employ to the satisfaction of the Consultant, an approved landscape contractor to supervise all landscape works. This person must be on site throughout the period of the landscape works from the time of arrival of the plant materials to completion of the maintenance period. The landscape contractor must also be a fluent Kiswahili speaker or have a translator available for his use at all times.

12.8 Installation

All materials are to be checked and approved by the Consultant prior to installation. All landscape procedures are to be carried out under the supervision of the landscape contractor.

12.9 Reinstatement

The Main Contractor is further responsible for reinstatement of all landscaped areas which are not specifically designated for renovation, to their original condition where construction works take place and damaged or contaminated existing landscape areas, or existing top soil.

12.10 General maintenance requirements

a) The Contractor is to be responsible for all landscape maintenance in areas of the site where construction work is to take place or is taking place. The Contractor is to submit his maintenance program to the Consultant prior to commencement of the building contract onsite.

b) The Contractor shall maintain during the period of the contract all trees, shrubs and other plants, also the grass areas within the contract boundaries at the end of the Defects Liability Period.

General maintenance shall include watering, weeding, mowing, cutting, cultivating, control of insects, fungi and other diseases by means of spraying with an approved insecticide or fungicide, pruning, adjustments and repair trees ties, repair of minor washouts and other horticultural operations necessary for the proper growth of grass and plants and for keeping the landscape neat in appearance.

12.11 Lawn maintenance

Shall consist of watering, weeding, fertilising, disease and insect pest control, aerating, replacement of unacceptable material, cutting and any other procedure consistent with good horticultural practice necessary to ensure nominal, vigorous and healthy growth.

a) Grass General: The grass should be cut regularly during the growing season. In the dry season cut to 50mm in length and in the wet season cut to 25mm in length. Weeded regularly to prevent being choked. The edges of the lawn should be trimmed and kept tidy to prevent grass creeping into shrub beds.

b) Fertilisation: Grass Should be fertilized regularly for a good lawn to be maintained:-

c) Top Dressing: Apply in April after the first rains; Apply a top dressing of 4 parts red topsoil and 1 part dry, well-rotted manure (well mixed together) to the lawn to a depth to 13mm. Rake top dressing over lawn and use it to fill in any uneven patches. (If there is no rain, water heavily after application). Repeat top dressing application in October or after the start of the rainy season.

Compound Fertilization: In June/July, apply a
Ammonium Sulphate: Every 2-3 months, (in between top dressing and compound fertilization) apply Ammonium Sulphate at a rate of 15 grammes per square metre. Water thoroughly after application. Heavy watering after application of fertilizer is essential to prevent "burning".

d) Aerating: Periodic tests should be made during the maintenance period to determine the degree of compaction existing in all planting areas and containers. If soil is compacted to a degree that water and air penetration is impaired. These areas shall be aerated by light digging with a long-toothed garden fork or spiked roller, in a manner not harmful to the plant material and to the satisfaction of the landscape consultant.

Aeration should not be done when the soil is either too wet or too dry.

In hot dry weather aeration should be followed by thorough watering.

Under normal conditions, aeration should be done at least twice a year.

e) Watering

During drought periods thorough soaking should be carried out once or twice a week. It requires from 2000 litres to 3000 litres of water for every 93 metres squared of lawn for each application to give an equivalent of 20mm to 40mm rain. This will moisten the soil from 80 -130mm deep.

Continuous heavy watering favours diseases. Water should be applied to new vegetative plantings in a fine spray that will not wash the soil away from the base of the young plants. It must be applied slowly so that the surface will not puddle and crust. Water lightly twice a day during establishment, then water heavily once a week. Grasses need about 25mm of water per week.

f) Protection of lawns

Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance. The contractor shall provide at his own expense, protection for all planted and seeded areas against trespassing and damage at all times. If any lawns, slope areas, trees or other plants are damaged or injured in any way, they shall be treated or replaced as required by the landscape consultant.

12.13 Shrubs

a) General: Shrubs should be weeded regularly, every two weeks. Inspected every two weeks for pests and diseases. Do not fertilize newly planted shrubs for three months. Remove ground cover plants from around the base of shrubs to avoid strangulation.

b) Fertilization: Fertilize shrub three times a year, starting three months after planting. Alternate major fertilization with manure and compound fertilizer; Manure fertilization. In April and in October, apply 6mm of well-rotted manure to all shrub beds. Water well after application.

c) Compound fertilization: In July and January, apply 15 grammes of 20N-10P-10K compound chemical grammes of bone meal. Lightly fork the fertilizer into the soil without disturbing the roots. Water well after applications. Minor Fertilization: Once a month apply BAYFOL or equal approved folia feed to all plants. This is applied as a spray and should be done before 9.00 a.m. and after 4.00 p.m. on dry days.

d) Watering: The Contractor will be required to water all plants as necessary, at any time as may be necessary or as directed by the landscape consultant.

During the hot season watering shall be carried out before 10.00 a.m. and after 5.30 p.m.

Watering to be applied through sprinklers or shower attachments to the hose pipes. Water administered directly from hose causes damage to the plant material and deteriorates the soil condition.

Damage caused by moving hoses pipes must be avoided and if occurred is to be rectified at the contractors expense.

e) Pruning and repair: Upon completion of planting work, trees may be pruned and any injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the result of transplanting operations. The plants shall be pruned in such a way as to preserve the natural character of the plants.

The pruning cut on small branches and shoots shall be made just above a bud and slanting downwards away from the side the bud is on. The cut should be 4mm above the bud.

Large branches shall be cut right back to level with the main trunk or stem and the edges of the cut shaved clean with a sharp knife to allow the plant to grow a protective cover quickly.

On all cuts over 75cm in diameter and on bruises and scars on the bark, the injured cambium shall be traced back to the living tissue and removed. The wound shall be coated with Arbeax or any other approved tree wound paint not containing lead.

The exercises shall be carried out under supervision of the landscape consultant.

f) Mulching: Rake up leaves which fall on the lawns and use these as a mulch on all the shrub beds. Make sure that only the leaves are placed in the shrub beds and no branches as this will attract white ants. Apply the dead leaves to the shrub beds to a depth of 100mm. The leaves will act as a mulch; it will provide humus to the soil, prevent weed and help retain moisture in the soil.

12.14 Trees

a) Watering: This should be as for shrubs but care must be taken to water heavily to encourage deep rooting.

b) Pruning: Prune the side branches (flush with trunk) to a height of 2m where they are to be walked under in lawns. Paint the wounds with ARBREX or equal approved.

c) Climbing plants: Ensure that the soil level is maintained around the base of the climbing vines and that the stems are encouraged to adhere to the wall surface, by use of steel wires as detailed or as instructed by the Landscape Architect.

d) Pests and Diseases: All plants should be regularly inspected for pests and diseases. Some plants are very susceptible to pests and diseases and should be sprayed once a month with ROGOR or equal approved.

For specific pests and diseases, spray as follows:-

Powder Mildew: spray with BAYLETON or BAYCOR or DITHANE-45, or equal approved.

Insects: Aphids, caterpillars, beetles:- spray with METASYSTOX or bury FUARANDAN around the
roots, or equal approved systemic insecticide.

Spider Mites: Spray with GUSATHION or CITRINOL, or equal approved.

White ants: bury ALFRIN or equal approved around the roots.

e) Surrounding each tree within the public open spaces a ring of protective stakes shall be maintained around the tree at a distance that will give protection to the canopy from damage by people and livestock.

SOIL

12.15 Soil preparation

a) Description of Work: This section includes the removal of weeds, rocks and debris from the soil surface, cultivation of the soil and addition of manure and fertilizers to the soil in preparation for planting. Where topsoil is to be imported, clear area of debris. Imported topsoil must be free of roots, weeds and debris.

Soil levels in all raised planter beds must be brought to within 35mm of the dpc level of the building, or to within 50mm of the top edge of the masonry where no dpc is installed.

b) Job conditions: Soil preparation is to be carried out after completion of building works in that area. This work is to be co-ordinated by the Contractor with other trades to ensure there will be no subsequent contamination of the prepared soil by building and other debris.

c) Materials: All manure is to be dry, well-rotted and a minimum of 12 months of age. It must be either horse, cow or chicken manure.

Compound fertilizers are to be 15N-10P-10K or approved equal and are to be of dry, granular consistency. Top soil obtained locally must be neutral, pH free of excess salt, and must be approved by the Consultant. Tests may be required by the Consultant at the expense of the Contractor.

d) Preparation: All weeds, rocks and building debris are to be removed prior to execution.

12.16 Installation

a) Remove soil to depth specified for each type of plant. Remove all large rocks (over 75mm diameter), root and debris from the excavated soil and then prepare soil planting mixture as follows. Mix together 4 parts excavated soil, 2 parts manure, 1 part imported topsoil, and 1/8 part compound fertilizer. Mix all components of the planting mixture together well and replace into the planting hole. Fill the hole with the soil mixture to a level above the original to allow for soil settlement. Thoroughly water the planting area until well soaked. Leave the area for 2 days before installation of plant materials.

b) The black soil is to be thoroughly mixed with cow manure and red soil at a ratio by volume of 1 part cow manure, 2 parts black soil, 4 parts red soil and the mixture is to be brought to a workable consistency.

If possible all landscaping ground preparation should take place one month before planting to allow for natural soil settlement.

Soil shall be disked to a depth of 10 to 15cm. If heavy equipment has been used, subslopping shall be used before diskig. After diskig, fertilizer shall be spread. Soil shall then be harrowed to reduce size of soil particle. A heavy float or drag harrow should be used to smooth surface.

c) The Contractor is to check that the required levels in all planting areas are satisfactory prior to commencing any works.

All subsoil must be broken up as described and the contractor must remove from the site all stones, timber and any other foreign objects larger than 50mm in any dimensions which are uncovered.

The Contractor shall ensure that subsoil be broken up to a depth of 300mm by hand fork or agricultural sub-soiler. Under no circumstances must the contractor carry out these works when the soil is in a saturated or unworkable condition. Any subsoil arising from the landscape operations such as tree pit excavations etc., must be deposited where directed by the landscape consultant. Excess of the subsoil to be removed from the site prior to planting.

d) Areas to be stripped of topsoil shall first be scraped clean of all brush, weeds, grass, roots and other material that will interfere with plant bed preparation.

All topsoil to a maximum depth of 300mm must be stripped in case of a raise or reduction in level and deposited where directed by the landscape consultant. The topsoil to be put back when the final level of the sub soil has been established.

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Excess subsoil to be removed from site prior to planting.

The Contractor is to check all final levels given on the drawings, prior to final cultivation operations, ensuring that the topsoil is free of pemicious weeds, large stones (diameter 5cm) and other foreign objects.

Final grading of the topsoil is to be carried out by ploughing, hoing, compacting and raking to ensure a true specified level, profile and slope to avoid dishing or other depressions where water may collect. All areas to be cultivated to be brought to a fine tilth before planting.

Topsoil shall be placed so that after final settlement there will be good drainage (and conforming to the elevations shown on drawings.) Maintain surfaces and place any additional topsoil necessary to replace that eroded before acceptance.

e) Materials used as additions to the soil or mulching shall be procured from sources approved by the landscape consultant and the Contractor shall notify the landscape consultant of the materials he proposes to use before carting to the site.

Cow manure and compost must be well rotted and matured. Compost must consist of wholly vegetable matter and shall contain no domestic or waste foods.

f) Inspection: Areas of soil prepared for planting are to be inspected and approved by the Consultant prior to planting.

GRASSING

12.17 Description of work

This section includes the planting of grass plugs to create a grass sward.

12.18 Job conditions

Areas to receive grass are to be properly prepared prior to planting. Soil in this area is to be prepared in accordance with the soil preparation section.

12.19 Materials

Grass "plugs" are to be Kikuyu type or of the same uniform species as specified. "Plugs" are to be free of weeds and any other grass species.
12.20 Area

a) All exterior ground areas within the limit of the contract, except surfaces occupied by buildings and structures and paving, except areas indicated to be undisturbed, shall be seeded or planted as shown on the drawings.

b) Furnish topsoil, finish grading, prepare bed, plant and maintain areas on the drawings.

12.21 Bed preparations

a) Grading - grade lawn areas to finished grades, filling as needed or removing surplus dirt and floating areas to a smooth, uniform grade as indicated on the plans. All lawn areas shall slope to drain.

b) Fertilizers: All lawn areas on the plans shall receive one handful of NPK (17:17:17) fertilizer, or equal approved, per 50cm x 50cm of surface area.

c) Thoroughly and evenly incorporate fertilizer with the soil to a depth of 8cm by disk or other approved methods. In areas inaccessible to power equipment, use hand tools. Adjacent to existing trees, the depth shall be adjusted to avoid disturbance to the roots.

d) General: Grasses are very heavy feeders on nitrogen and respond in proportion to the amounts available in the soil.

e) Ground preparation should ideally be carried out 6 months before planting.

f) Soil preparation is to be carried out to a depth of 300mm.

g) The top 150mm shall be well pulverised and levelled with a rake. One or two days before planting the ground shall be thoroughly watered.

h) The fresh young runner cuttings shall be planted at a depth of 70-100mm with 100mm centres in each direction. The cuttings shall be pressed in with the hand as planting proceeds. Once the planting is finalized a fertilizer to stimulate root growth shall be applied. Top dress CAN, or equal approved, fertilizer at a rate of one handful per 50cm x 50cm of surface area.

i) The ground shall be well watered after planting.

12.22 Sprigging/cutting

All cuttings heat readily when in large piles. Every effort should be made to keep them covered and damp until used. Only as many cuttings should be on hand as can be planted in one day.

12.23 Description of works

This section includes the planting procedure for shrubs and trees.

12.24 Time of planting

a) The planting shall be commenced when other divisions of this work, including placing of topsoil, to the finished grade, has progressed sufficiently to permit planting.

b) Initiation of planting shall coincide with the start of the rains, or the overall programme of the project permitting.

12.25 Layout

Planting shall be located as indicated on the plan except where obstructions overhead or below the ground are encountered or where changes have been made in the construction. Necessary adjustments shall be approved by the landscape consultant or their representative.

12.26 Setting plants

a) No planting pits or trenches shall be dug until the proposed locations for tree and grass positions have been staked out on the ground and approved by the landscape consultant.

The dimensions should be followed as per the plan, wherever possible. If changes are necessary the landscape consultant's confirmation must be obtained.

b) All holes shall be dug with straight vertical sides in a square shape with a crowned bottom.

c) All plants shall be set to the ultimate finished grade, so that they will be left in the same relation to the surrounding grade as they have stood before being moved.

d) Excess excavation shall be removed from the site.

e) No plant shall be bound with rope or wire at any time so as to damage bark, break branches or destroy its natural shape.

f) Each back-filled pit is to be partially dug out to a sufficient width and depth adequate to accept the root ball. The required amount of fertilizer is to be spread on the bottom before the actual planting exercise.

g) Care must be taken in removing the root ball from it's container so as to cause the minimum disturbance to the fibrous roots. The topsoil/manure mixture is then to be firmed around the root ball whilst keeping the stem upright, the stem base slightly below or at ground level.

h) A slight saucer with a lip of 10cm shall be formed around each tree and shrub to hold additional water.

i) At the end of the raining season a layer of 50cm of dried grass or dried leaf cuttings, for mulching purposes, is to be laid over the soil in the prepared saucer and cover that whole area, in order to minimise evaporation.

12.27 Planting season

a) Planting shall be done within the following dates, contract programme allowing.

Long rains from March until the end of May.

Short rains from October through to December.

- If special conditions exist, which may warrant a variance in the above planting dates, a written request shall be submitted to the landscape consultant, stating the special conditions and the proposed variance. Permission for the variance will be given if, in the opinion of the landscape consultant, the variance is warranted.

b) The Contractor shall commence work within 10 days after receiving notice from the landscape consultant.

SPECIFICATIONS
consultant and shall continue until completion as indicated in the progress schedule.

c) At the opinion and the full responsibility of the contractor, planting operations may be conducted under unseasonable conditions without additional compensation.

12.28 Backfilling of planting pits and planting beds

1) Planting pits and beds to be back-filled carefully to fill all voids and avoid breaking or bruising the roots.

b) The backfill is to be carried out in 150mm layers and well compacted by ramming. Finally the area to be brought to a fine tilth at planting depth.

c) Water the filled pit thoroughly and allow water to soak away. If necessary add more back-fill to bring to level.

12.29 Tree Pits

a) Tree pits shall be of the following dimensions:

- 2000mm x 2000mm x 1500mm depth.

b) The landscape consultant may instruct a different size where the site conditions require.

c) The final level of the topsoil is to be 25mm below all paved edges and minimum of 150mm below the finished floor level of buildings where directly abutting the walls.

d) The pits are to be well watered and allowed to settle for 3 to 5 days prior to planting.

e) A slight saucer with a lip of 10cm shall be formed around each tree to hold additional water.

f) At each tree of a minimum height of 2000mm, 2 or 3 strong gum or sisal stakes, not less than 50mm in diameter and not less than 2000mm in height, are to be placed alongside the tree before backfilling 600mm into the base at 450mm distance from the stem.

The tree is to be securely tied to the stakes with rubber bands not less than 30mm in width. A strip of hessian of triple thickness should be placed between the stem and the rubber bands to prevent chaffing. The hessian shall be removed and tied elsewhere every six months until the tree can stand without support.

g) The Contractor shall be required to make the necessary adjustments to the planted material in order to correct sinkage effects due to weather conditions or any other damage.

12.30 Square pits in paved areas

<table>
<thead>
<tr>
<th>Diameter of ball (cm)</th>
<th>Size of ball (cm)</th>
<th>Depth of pit (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 - 100</td>
<td>175 - 175</td>
<td></td>
</tr>
</tbody>
</table>

a) The depth spec Size of pit plant pits (cm) shall be the depth below finished grade required to accommodate beneath the ball or roots, a bed of topsoil not less than 15cm in depth. The ball or roots shall rest on this bed when the plant is properly set to finished grade.

b) Where the surface of sub-surface conditions prevent digging a tree pit to specified dimensions, excavate in other directions so as to provide a pit having the same cubic content as called for.

c) Where unsatisfactory, sub-grade soil conditions are encountered, such as building construction debris, in the excavation for tree pits, increase the size of the pits. Except for tree pits over 350cm in diameter, increase pit sizes by 1/3 their diameter, and add 15cm in depth to the sizes of pits called for in the preceding table on pit sizes.

12.31 Clean Up

Upon completion of all construction and before final acceptance, the contractor shall broom clean the entire paved area. All tools, surplus material, equipment, debris, etc., shall be left in a neat and acceptable condition, such as to meet the approval of the owner.

The Contractor shall periodically or as directed during the progress of his work, remove and properly dispose of the debris and keep the premises reasonably clear of hazardous obstructions.

Upon completion of his work, he shall remove all his temporary construction facilities and unused materials provided for the work, and put the premises in a neat and clean condition, and do all the cleaning required by the specifications.

Trash burning on the site will be subject to prior approval of the landscape consultant and existing local regulations.

During the course of planting excess and waste materials shall be continuously and promptly removed, lawn areas kept clear and all reasonable precautions taken to avoid damage to existing shrubs, plants and grass.

When planting in an area has been completed, the area shall be thoroughly cleaned up. The debris, rubbish, subsoil and waste material shall be cleaned up and removed from the property.

Existing grass areas which have been injured by any of the works shall be regraded and planted and the entire area, when completed, shall be neat and clean to the satisfaction of the landscape consultant.

In the event that “plant operations” are executed after the lawns have been installed, the attention of the contractor is called to the paragraph “protection” following.

Protection: The Contractor shall protect all plants and lawns from damage at all times. The moving of heavy equipment or material over the lawn areas shall be done on planks or pontoons.

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12.32 Restoration

All pavements, planted areas, structures and sub-structures not specifically provided for in the contract disturbed by the contractor by the execution of the work, shall be restored by the contractor, in a manner satisfactory to the Consultant, to their original condition at no additional cost.

12.33 Inspection and acceptance

The landscape consultant shall inspect all work for substantial completion upon written request from the contractor. The request shall be received at least 10 calendar days before the anticipated date of inspection. Upon completion and re-inspection of all repairs or renewal necessary in the judgement of the landscape consultant, the landscape consultant shall certify in writing to the owner as to the substantial completion of the latter work, upon acceptance by the owner the owner shall assume maintenance of the lawn areas.
SECTION 13
EXCAVATIONS AND EARTHWORKS

13.1 Formation Level

Formation level on embankments and in cuttings shall be the surface level of the ground obtained after completion of the earthworks, i.e. the underside of the sub-base, or where no sub-base is specified, the underside of the base. Any excess depth unnecessarily excavated below formation level shall be backfilled with material acceptable for construction and compacted as directed by the Engineer and no payment shall be made for the excess excavation or for the filling and compacting. The levels and tolerance of irregularity of the surface of the course shall be within the limits specified in Clause 17.7 for sub-grade.

13.2 Surface Soil

Unless otherwise directed by the Engineer all surface soil shall be removed from the area to be used for cuttings and embankments and stockpiled for re-use and for any purpose such as the soiling of slopes of cuttings and embankments, herms, verges, central reserve and the preparation of beds for the cultivation of trees and shrubs.

Surface soil shall be regarded as soil which on visual examination can be seen to have been broken down by agricultural cultivation and/or is seen to be capable of supporting vegetable growth.

Surface soil shall be removed to an average depth as shown on the Drawings or specified in the Bills of Quantities.

The Contractor shall make his own arrangements for temporary storage sites for heaps of surface soil either inside or outside the Site of the Works to suit his convenience. The cost of all operations needed in excavating, loading, carting, depositing and stacking, together with arranging for the storage sites, the hire or purchase of land therefore and all necessary access roads for this purpose is to be included in the item in the Bills of Quantities for stripping surface soil and is to be quoted whatever the nature of the underlying sub-soil.

All unsuitable soil comprising or underlying surface soil shall be excavated and run to spoil in accordance with Clause 2.7.

13.3 Soiling of Side Slopes and Verges

Soiling and compacting of the side slopes of cuttings and embankments shall be carried out to an even surface with a thickness within the range 100 mm - 200 mm, or in the case of verges as stated in the Bills of Quantities with surface soil as previously stockpiled or from an approved source.

Grass planting shall be carried out in accordance with Clause 13.42.

13.4 Definition and Classification of Excavated Material

Excavation in solid rock in the Bills of Quantities will be itemised in three Classes:

(i) Class I:
Soft rock of the type known locally as "tuff" or "magadi" which in the opinion of the Engineer cannot be considered as hard rock but which considerably increases the amount of labour needed for its removal shall be known as Class I rock. Murram and Kunker is specifically excluded and will be reckoned as common excavation.

(ii) Class II:
Very weathered blacktrap or lava containing many fissions and faults shall be known as Class II rock. This type of rock contains stones and boulders of unweathered or incompletely weathered blacktrap or lava. A boulder or outcrop of hard rock 13.5 cu. metre or less, and first quality Nairobi blue, grey or green building stone in a formation which is massive and geologically homogeneous, will be deemed to be Class II rock.

(iii) Class III:
Blacktrap in a formation which is massive and geologically homogeneous shall be known as Class III rock.

The opinion of the Engineer in classifying rock shall be final and binding.

Common excavation shall mean excavation in any material which are not solid rock as defined in this Clause.

All excavation shall be classified either as unsuitable materials or as suitable material.

Unsuitable material shall comprise:

(i) Material from swamps or marshes, silt, perishable material, slurry or mud; or

(ii) Any material:
(a) which is a highly organic clay or silt;
(b) which is clay having a liquid limit exceeding 8. and/or a plasticity index exceeding 55;
(c) which is outside the limits of moisture content specified in the earthworks series of Clauses either when excavated or thereafter;
(d) which is susceptible to spontaneous combustion;
(e) consisting of such domestic refuse which by virtue of its physical or chemical composition or moisture content will not compact to form a stable fill.

Suitable material shall comprise all that which is acceptable in accordance with the requirements of the Specification for use in the Works, whether obtained from within or without the Site. Any reference in this and other Clauses of the Specification to suitable material and unsuitable material shall have the meanings defined above.

For the purpose of selection for use in earthworks all common excavation shall be classified as either plastic or non-plastic. Non-plastic materials shall be defined as those on which it is impossible to carry out a plasticity index text and shall include "coarse-grained, non-cohesive materials" included in Table 1 of British Standard Code of Practice CP 2001.

13.5 Storage and Handling of Explosives and Blasting

The removal of hard materials by use of explosives will normally be permitted subject to compliance by the Contractor in all respects with the Explosive Laws of Kenya.

In the Bills of Quantities rock may be sub-classified into rock where blasting will be permitted subject to this Clause and rock where blasting will not be permitted.

The Contractor shall provide proper buildings or magazine in suitable positions for the storage of explosives in manner and quantities to be approved; he shall also be responsible for the prevention of any unauthorised issue or improper use of any explosives brought on the Works and shall employ only experienced and responsible men to handle explosives for the purpose of the Works.

The shots shall be properly loaded and tamped and, where necessary, the Contractor shall use heavy mesh blasting nets. Blasting shall be restricted to such periods and such parts of the Works as the Engineer may prescribe. If, in the opinion of the Engineer, blasting would be dangerous to persons or property or any finished work or is being carried on in a reckless manner, he may prohibit it, and order the rock to be excavated in other means and payment will be made at the rate for rock excavation where blasting is permitted. The use of explosives by the Contractor in large blasts, as in seams, drifts, shafts, pits, or large holes, is prohibited unless authorised in writing by the Engineer. In the event of want of rock through any such blasting, the Contractor shall, if required by the Engineer, furnish an equivalent amount of approved materials for embankments, 1 cu. metre or rock insitu being taken to equal 2.5 cu metre of material in embankment.

13.6 Excavation of Cuttings

The Contractor shall carry out the excavation of cuttings in accordance with the Drawings and shall adhere to the slopes, levels, depths and heights shown thereon.

The sloping sides of all cuttings shall be cleared of all rock fragments which move when prised with a crowbar and are therefore liable to cause injury or damage through falling.

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Where excavation reveals a combination of suitable and unsuitable materials, the Contractor shall, wherever the Engineer considers it practicable, carry out the excavation in such a manner that the suitable materials are excavated separately for use in the Works without contamination by the unsuitable materials.

If any suitable material excavated from within the Site is, with the agreement of the Engineer, taken by the Contractor for his use (i.e. as material for pavement courses) and not in consequence for the formation of embankments, or soiling of slopes of cuttings and embankments or verges, sufficient suitable filling material to occupy, after full completion, a volume corresponding to that which the excavated material occupied, shall, unless otherwise directed by the Engineer, be provided by the Contractor from his own resources.

No excavated material shall be dumped or run to spoil except on the direction or with the permission of the Engineer, who may require material which is unsuitable to be retained on Site. Material used for haul roads shall not be re-used in embankments, or elsewhere without the permission of the Engineer.

The completion of cuttings shall, unless otherwise permitted by the Engineer, be undertaken in two stages. First the area between the extremities of the carriageway(s), including verges, shall be excavated to a level 300 mm above formation level whereasupon constructional traffic may continue to be allowed to use the surface so formed.

Second, when it is necessary to complete to formation level, this excess of material shall be trimmed off as a single operation and disposed of either elsewhere in the Works if regarded by the Engineer as suitable material or, if not, run to spoil.

When the height above formation level has been reduced below 150 mm the movement and use of constructional plant, other than that used to complete this operation, shall be in accordance with the requirements of Clause 17.17.

This trimming operation shall be regarded as the commencement of construction of the pavement.

13.8 Side Slopes

Should the slopes of any cutting be excavated beyond the widths shown on the Drawings or directed by the Engineer the Contractor shall make good each affected area in a manner satisfactory to the Engineer.

13.9 Surface Treatment of Formation

If required, after final preparation of the sub-grade, the surface of the formation shall within 24 hours of such final preparation or as soon as practicable thereafter be surface dressed with bitumen, as stated in the Bills of Quantities. The surface dressing shall be carried out as specified in Clause 18.13 and shall include blinding with 5mm - down crushed rock at the rate of 6kg per sq. metre. Where a particular area of formation is to be covered with a compacted and sealed sub-base within 24 hours of its preparation the surface dressing of the formation may be omitted. If, to whereof such sealing membrane for the formation or the sub-base having been ordered promptly by the Engineer, the Contractor allows the moisture content of accepted compacted materials to increase to a value above that which would have been acceptable for compaction, the Contractor shall allow the material to revert to such an acceptable moisture content and, if so directed by the Engineer, recompact the surface before sealing.

13.10 Compaction of Earthworks

All filling material used in earthworks shall be compacted to specification by plant approved by the Engineer for that purpose.

The Contractor shall submit to the Engineer for approval his proposals for the compaction of each main type of material to be used in the embankments, including those in relation to the types of plant, the number of passes and the loose depth of layer. The Contractor shall carry out compaction trials, supplemented by any necessary laboratory investigations, as required by the Engineer, using the procedure proposed by the Contractor for earthworks, and shall satisfy the Engineer that all the specified requirements regarding compaction can be achieved. Compaction trials with the main types of material likely to be encountered shall be completed before the Works with the corresponding materials will be allowed to commence.

Work on the compaction of plastic materials in embankments shall proceed as soon as practicable after excavation and shall be carried out only when the moisture content is not greater than 2 percent above the plastic limit for that material. Where the moisture content of plastic material as excavated is
higher than this value the material shall, unless otherwise directed by the Engineer, be run to spoil. If the Contractor allows the moisture content of suitable plastic materials to increase to a value which is unacceptable for compaction he shall, unless he prefers at his own expense to wait until the material has dried sufficiently for acceptance again as suitable material, run such materials to spoil and provide an equal volume of material suitable for filling, both without extra charge.

Work on the compaction of non-plastic materials in embankments shall be carried out only when material has such a moisture content as is within the range from 1 percent wetter to 2 percent drier than the moisture content of the material in cuttings or borrow pits when measured on samples obtained from at least 300 mm above the level of the water table as indicated by the presence of free water in the excavation. Nevertheless if with any material the Engineer doubts whether satisfaction will be obtained within the above moisture limits he may require compaction to proceed only when the limits of the moisture content for the compaction of non-plastic materials are within the range of the optimum moisture content and 3 percent below the optimum moisture content as determined by the laboratory compaction test method described in British Standard 1377 : Methods of Test for Soil Classification and Compaction.

If any such non-plastic material on excavation is too wet for satisfactory compaction and the Engineer orders the moisture content to be lowered or raised such work shall be treated as included in the rates. All adjustment of moisture content shall be carried out in such a way that the specified moisture content remains uniform throughout compaction.

If the Contractor allows the moisture content of suitable non-plastic material to change after excavation to a value unsuitable for compaction he shall raise or lower the moisture content as required above, or the Contractor shall, if so directed by the Engineer, run the material to spoil and replace it with an equal quantity of material suitable for compaction.

Work shall be continued until a state of compaction is reached throughout the embankments, including especially the slopes of embankments and the immediate approaches to bridge abutments such that at least 9 out of every 10 consecutive samples taken of the compacted material have a relative compaction determined according to BS 1377 of at least the following percentage of the maximum density at the optimum moisture content:

(a) for the topmost 600 mm below formation level a maximum density of 100 percent;
(b) for the remainder below formation a maximum density of 95 per cent.

If with non-plastic materials the compacted material has become drier in the interval between the completion of compaction and the measurement of the state of compaction, then the moisture content to be used for the calculation of the air content shall be the mean moisture content for the compaction of such materials as specified above.

Each layer of rock used as rock-fill in embankments shall be systematically compacted by at least 6 passes of a tower vibrating roller weighing not less than 3 tonnes or a grid roller weighing not less than 13 tonnes dead weight or other approved plant. Where, however, it is established that rock ca be compacted to the requirements for common excavation, the rock shall be compacted to such latter requirements.

13.11 Excavation below Embankment in Materials Unsuitable for Construction

Before forming the embankment any unsuitable material naturally occurring on the Site shall be removed to such depths and over such area as may be directed by the Engineer and shall be run to spoil. The resultant excavation shall be back-filled with suitable material deposited and compacted as specified for the forming of embankments. Nevertheless where in these circumstances such back-fill has to be deposited below standing water, compaction may be omitted provided that the material used is completely free draining.

If ordered by the Engineer as an alternative method of construction, approved rock-fill material shall be placed directly on the naturally occurring unsuitable material to such total depth that on completion of compaction negligible deflection of the surface occurs due to the passage of vehicles hauling in the rock. The rock-fill material shall be deposited in accordance with the requirements of Clause 13.7, and compacted so as to comply with the requirements of Clause 13.10 for the compaction of rock. Such work will be dealt with as a Variation of the Works.

13.12 Benching

Where an embankment is to be placed on appreciably sloping ground, the surface of the ground shall be benched in steps or trenches, as shown on the Drawings or directed by the Engineer including, if necessary, any under-draining of the site.

13.13 Excavation below Formation in Cuttings in Materials Unsuitable for Construction

Where unsuitable material is encountered in the sub-grade it shall be excavated to such depths and over such area as the Engineer shall directed and be run to spoil. The resultant excavation shall be back-filled with suitable material deposited in layers each not exceeding 225mm loose depth and compacted in the manner specified for the forming of embankments. Nevertheless, where in these circumstances such back-fill has to be deposited below standing water compaction may be omitted provided that the material used is completely free draining.

If ordered by the Engineer as an alternative method of construction, approved back-fill material shall be placed directly on the naturally occurring unsuitable material to such total depth that on completion of compaction negligible deflection of the surface occurs due to the passage of vehicles hauling in the rock. The rock-fill material shall be deposited in accordance with the requirements of Clause 13.7, and compacted so as to comply with the requirements of Clause 13.10 for the compaction of rock. Such work will be dealt with as a Variation of the Works.

13.14 Embankment at Approaches to Bridges

To avoid interference with the construction of bridge abutments and wing walls, the Contractor shall, at the points to be determined by the Engineer, suspend work on embankments and/or cuttings forming the approaches to any such structures until such time as the construction of the latter is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage to the bridge works. The cost of such suspension of work shall be included in the prices entered in the Bills of Quantities for excavation from which embankments are formed.

13.15 Embankments over Bridges, Culverts and Drains

In carrying embankments up to or over bridges, culverts, or pipe drains care shall be taken by the Contractor to have the embankments brought up equally on both sides and over the top of any such structures. Earth embankments shall be formed and compacted in layers as specified in Clause 13.7 and 13.10 and, in rock embankments, the rock filling shall be carefully packed for such distance back as the Engineer may direct. The cost of these works shall be included in the prices entered in the Bills of Quantities for the excavation from which embankments are formed.

13.16 Side Grips

Where directed by the Engineer side grips as shown on the Drawings shall be formed through verges for surface water drainage and the excavated material disposed of as directed.

13.17 Stone Revetments

Where shown on the Drawings, the slopes of embankments, rivers, streams, watercourses and other surfaces shall be protected against water or other action by hand-set stone - the largest of which shall be used in the bottom or where the current is greatest - shall be roughly dressed on the bed and face, and roughly square to the full depth of the joints. No rounded boulder shall be used, or stones less than 225mm in depth or 0.05 cu. metre in volume. The stones shall be laid to break bond, and shall be well bedded on to a 75mm layer of gravel or fine rubble rammed to a uniform surface and the whole work finished to the satisfaction of the Engineer. Where required, a trench shall be
13.18 Completion of Earthworks

The formation shall be properly shaped and regulated and compacted in accordance with Clause 13.10. When completed the formation shall be at the required level and generally parallel to the required finished surface of the road.

13.19 Curves

Where the alignment of the carriageway is curved, the bottoms of cuttings and the tops of embankments shall be formed with the super-elevation and increased widths shown on the Drawings or as the Engineer shall direct, to suit the degree of curvature of the alignment.

13.20 Industrial Refuse on Site

Industrial refuse other than artificial deposits of industrial waste or shale found on the Site shall be removed and disposed of in a spoil heap to be provided by the Contractor.

13.21 Removal of Industrial Waste, etc

Artificial deposit of industrial waste or shale found on the Site shall be removed and disposed of as directed by the Engineer. Should any particular deposits consist of or contain material which in the opinion of the Engineer is suitable for incorporation in embankments, all such material shall be used accordingly and deposited in layers and compacted as specified in Clause 13.7 and 13.10. The prices entered in the Bills of Quantities for the excavation of this material shall include for the excavation of the material and the loading, transportation, disposal and compaction of same as and where directed.

13.22 Land Slips

Remedial works and/or the removal of materials in slips, slides or subsidence and overbreaks of rock extending beyond the lines and slopes, or below the levels shown on the Drawings of required by the Engineer, will not be paid for unless such occurrences are shown to have been beyond the control of the Contractor, and not preventable by the exercise of due care and diligence on his part.

13.23 Classification of Slips

The classification of material from slips or slides will be in accordance with its condition at the time of removal, regardless of prior condition. Measurement of overbreak in rock excavation shall be that of the space originally occupied by the material before the slide occurred and regardless of its subsequent classification.

13.24 Borrow Cuttings and Pits

Where, for any reason, it becomes necessary to form borrow cuttings or borrow pits, these shall be located and the work executed in all respects to the instruction of the Engineer. They shall be regular in width and shape suitable for ready and accurate measurement, and shall be properly graded and drained and finished with neatly trimmed slopes.

13.25 Road Approaches and Access Roads

The excavations and embankments in road approaches, junctions, access roads and fringe lands, shall be of such form and dimensions as the Engineer may direct, and in all respects finished as specified for those of the main carriageway. The materials arising from such excavations shall be disposed of as directed by the Engineer.

13.26 Streams, Watercourses and Ditches

Excavation carried out in the diversion, enlargement, deepening, or straightening of streams, watercourses, or ditches shall be performed as directed by the Engineer. The rates for such excavations shall include for the necessary trimming of slopes, grading of beds, disposal of excavated materials and all pumping, timbering, works and materials necessary for dealing with the flow of water.

13.27 Filling Old Watercourses

Where watercourses have to be diverted from the sites of embankments or other works, the original channels shall be cleared of all vegetable growths and soft deposits and carefully filled in with approved materials deposited and compacted as specified in Clauses 13.7 and 13.10.

13.28 Open Ditches

Open ditches for drainage purposes shall be cut where and of such cross section as the Engineer shall direct and where so required by him they shall be constructed before the cuttings are opened or the embankments begun. The sides shall be dressed fair throughout and the bottoms accurately graded so as to carry off the water to the outlet to be provided. The material excavated from the ditches shall be disposed of as directed by the Engineer.

13.29 Clearing Existing Ditches

Where directed by the Engineer existing ditches shall be cleared by removing vegetable growths and deposits. The sides shall be shaped fair throughout and the bottoms properly graded. Material removed from existing ditches shall be disposed of in tops provided by the Contractor. The rates included in the Bills of Quantities for clearing ditches shall include for maintaining and keeping clean.

13.30 Side Slopes in Rock Cuttings

Where rock is encountered in cuttings the side slopes shall be cut out at least to the lines, levels, and slopes shown on the Drawings or directed by the Engineer.

13.31 Excavations for Foundation Pits and Trenches

Pits and trenches for foundations for bridges, culverts, walls and other structures, except those covered under Clause 16.1, shall be taken out to the levels and dimensions shown on the Drawings or to such other levels and dimensions as the Engineer may direct. The bottoms of all excavations shall be carefully levelled and if necessary stopped or benched horizontally. Any pockets of soft material or loose rock and fissures in the bottoms of pits and trenches shall be removed and the cavities so formed filled with concrete of the appropriate Class. When any excavation has been taken out and trimmed to the levels and dimensions shown on the Drawings or directed by the Engineer, the Engineer shall be informed accordingly so that he may inspect the completed pits or trenches and no excavation shall be filled in or covered with concrete until it has been so inspected and the Contractor has been authorised to proceed with the work. All refilling shall be deposited in embankments, or otherwise disposed of, as directed. All excavations shall be kept dry, and all baling and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations for foundation pits and trenches shall be included in the prices for excavation.

13.32 Excavation for Cut-off Walls

The rate for excavation of trenches for cut-off walls shall include for cutting one face of the excavation true to receive concrete and for any extra concrete of the appropriate Class specified for the cut-off walls which is required to fill up over excavation on this face.

13.33 Excavation for Foundations Below Open Water

The rates for excavation for foundations below the agreed water level shall include for the cost of all temporary close timbering and shoring, sheet piling, coffer dams, caissons, pumps and other special appliances required.

13.34 Foundation Pits and Trenches of greater width and depth than necessary

The Contractor shall not be entitled to payment in respect of excavation to any greater extent, whether horizontally or vertically, than is necessary to receive any structure for which the excavation is intended, except where a separate item is provided for additional excavation for working space, timbering, or other temporary work. Excavation to a greater depth or width than is directed shall be made good with concrete of the appropriate greater width than is necessary to be filled and tightly packed with suitable material.

13.35 Earthworks to be kept free of water
The Contractor shall arrange for the rapid dispersal of water shed on to or entering the earthworks from any source at any time during construction, or of water which is shed onto the completed sub-grade. 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 cutting 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 tables the Contractor shall pay due regard to the stability of all structures.

The cost of compliance with the requirements of this Clause shall be covered in the rates for such works.

13.36 Supports for Foundation Pits and Trenches

The sides of pits and trenches shall where necessary be adequately supported to the satisfaction of the Engineer by timber or other approved means.

13.37 Refilling of Foundation Pits and Trenches and Removal of Excavation Supports

Refilling of foundation pits and trenches shall be carried out only after the foundation and structural works within the excavations have been inspected and approved by the Engineer. Unless otherwise directed by the Engineer all filling shall consist of approved excavated material which shall be deposited and compacted, using approved plant, in layers not exceeding 225mm loose depth, to a dry density not less than that of the adjoining soil. Timber sheeting and other excavations supports shall be carefully removed as the filling proceeds except as otherwise specified, but the removal of such supports will not relieve the Contractor of his responsibility for the stability of the Works.

Where directed by the Engineer timbering, sheeting or other excavation supports shall be left in foundation pits and trenches and any timber so left in will be measured and paid for at the prices entered in the Bills of Quantities except where, in the opinion of the Engineer, the necessity for leaving the timber in has arisen from negligence on the part of the Contractor.

The number of separate layers deposited and compacted at any one time shall be subject to the approval of the Engineer.

13.38 Use of Vibratory Compaction Plant

Where vibratory rollers or other vibratory compaction plant are used the mechanism for vibration shall be kept working continuously during compaction operations, except during periods when the Engineer permits or directs discontinuance of vibration.

Unless otherwise permitted by the Engineer, the frequency of vibration shall be maintained within the range of amplitude and frequency recommended by the manufacturer’s of the plant for the material to be compacted.

The frequency shall be recorded by a tachometer indicating speed of rotation of any shaft producing vibration.

13.39 Provision of Spoil Heaps

The Contractor shall provide spoil heaps at his own expense for the disposal of surplus materials and all rubbish collected when clearing the Site and during the Construction of the Works. The sites for these shall be approved by the Engineer.

13.40 Stone Pitching

Stone pitching shall be hand-placed and bedded on a 50mm thick layer of Grade 15 concrete. The stones shall be roughly 150mm x 200mm x 150mm thick and rough hammer dressed on the face and sides. The stones shall be jointed in 1:3 cement/sand mortar.

The stones shall break joint in every direction and the interstices shall be packed with stone chippings.

Where the thickness of pitching is such that two or more layers of stones are required the layers shall be keyed together by means of stones projecting from the lower to the upper course and such stones shall be provided at the rate of two for every one square metre.

13.41 Gabion Protection

Gabions shall be of the hexagonal wire mesh type, with mesh dimensions of 80mm x 100mm. The minimum dimension shall not exceed 83mm. Wire shall be galvanised prior to weaving the mesh to resist corrosion from river water.

All wire used in the fabrication of the gabion and in the wiring operation during construction shall be in accordance with BS 1052: 1980. (1986) Mild Steel wire having a tensile strength of 38-50 kg/mm². The sizes of the wires shall be in accordance with the table below.

All wire shall be galvanised to BS 443: 1982 ‘Zinc coatings on steel wire’ with the minimum weight of zinc coating in accordance with the table below.

| Mesh Wire          | 2.7 | 6.0 |

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All wire used in the fabrication of gabions and in the wiring operations during construction shall, after galvanising, have extruded onto it a coating of polyvinyl chloride compound referred to as PVC. The coating shall be black in colour, not less than .04mm thickness and shall be capable of resisting deleterious effects of exposure.

The gabions shall be of the following standard sizes:

- 2m x 1m x 0.5m
- 2m x 1m x 1m
- 6m x 2m x 0.3m

The gabions shall be provided with diaphragms to divide the boxes in compartments with a maximum dimension in any direction of 1m.

Joints shall be flexible and shall consist of not less than one and a half full turns of wire, at each mesh point of the joint line.

Gabions shall be generally equivalent to or better than those manufactured by SPA Officine Maccaferrì, Via Agresti®6, Bologna, Italy, PO Box 396 (Telex 51.649 Gabion®). Alternative materials shall be subject to the Engineer’s approval.

Rockfill for gabions shall consist of hard durable clean rock derived from a quarry approved by the Engineer. The maximum size shall be 220mm and the minimum size 120mm. Up to 10% of some smaller blinding material (minimum 75mm) to fill the internal voids at the top will be allowed.

The gabions shall be placed in their final positions overlying synthetic filter membrane prior to filling with rock and shall then be tied together and filled with rock. After filling with rock the tops shall be closed and securely tied. The larger rocks shall be placed on the upper face of the gabion in order to present a reasonably closed surfaced surface. All assembly, erection, stretching, filling with rock and final filling shall be in accordance with the instructions as issued by the manufacturer.

The synthetic filter membrane shall be a non-woven fabric such as Terram 1000 or equivalent approved.

13.42 TOP SOILING AND GRASSING

Embankment slopes and other areas to be grassed shall be covered with a consolidated layer of organic topsoil in accordance with Clauses 2.3 and 2.4 not less than 15.0mm thick. The surface shall be well raked, brought to a fine tilth and rivetted with interlaced split bamboo or such other methods as are necessary to prevent erosion. Grassing may be established by either seeding or planting of runners.

Where directed by the Engineer, grass trials shall be undertaken to determine the optimum mixture of seed fertiliser and herbicides for the effective establishment of grass areas.

Surfaces required to the grassed shall be planted with ‘Kikuyu’ type runners or other approved local grass obtained from an approved local source and shall be

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planted at approximately 15 mm x 15 mm spacing so as to form a dense protective mat.

Where seeding is carried out, the mixture of grass seed, fertiliser and herbicide shall be determined after grassing trials.

Soiling and grassing of slopes shall be carried out immediately a slope has been formed and shall be watered as necessary to ensure quick development of grass coverage.

Grass shall be replanted if the first or subsequent plantings are unfruitful or if for any reason the grass is destroyed. Any damage caused by rain or other reason shall be made good immediately.

Grass shall be kept free of weeds and shall be cut, watered, fertilised and weeded as necessary. The Contractor shall supply all labour and attendance for this purpose until the end of the Period of Defects Liability.

By the time of the final construction inspection all areas to be grassed shall be substantially covered with healthy, well established, firmly rooted grass and the area shall be free from erosion rills and channels.
14 CONCRETE

14.1 GENERAL

The standard of materials and of workmanship shall not be inferior to the recommendations of the current:

(a) British Standard Code of Practice BS 8110 - The Structural Use of Concrete

(whichever is applicable

Or

(b) British Standard Code of Practice BS 8007 - Design of concrete structures for Retaining Aqueous Liquids

The requirements outlined in the above and of this Specification, the Specifications CONCRETE as and when required by the Engineer shall be supplied as soon as possible to the Engineer.

No material shall be used in the Works until prior approval for its use has been given by the Engineer; neither shall any change in the nature, quality, kind, type, source of supply or manufacture be made without the Engineer's permission.

Names of manufacturers and test certificates for materials not supplied by the Employer shall be supplied by the Contractor.

The cost of providing samples and the cost of carrying out tests required by 14.6 (except as otherwise provided in the Conditions of Contract) together with the cost of supplying equipment for sampling and site testing indicated in columns 3 and 4 of Table 14.8 of this Section of the Specification shall be borne by the Contractor (see also Clause 14.6).

During the progress of the Works, consignment notes for materials not supplied by the Employer shall be supplied to the Engineer giving details of each consignment.

The Contractor shall provide all samples required by the Engineer as soon as possible after contract award. No deliveries in bulk shall be made until the samples are approved by the Engineer. All condemned material shall be removed from the site within 24 hours.

A competent person approved by the Engineer shall be employed by the Contractor whose duty will be to supervise all stages in the preparation and placing of the concrete. All cubes shall be made and site tests carried out under his direct supervision, in consultation with the Engineer.

All materials which have been damaged, contaminated or have deteriorated or do not comply in any way with the requirements of the current Specifications CONCRETE shall be removed immediately from the site at the Contractor's own expense. No materials shall be stored or stacked on suspended floors without the Engineer's prior approval.

The use of the word "approved" in this Specification refers to the approval of the Engineer.

Cross reference between certain clauses of this Specification have been shown in brackets following the particular item.

14.2 CONCRETE

Requirements

The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, having regard to the structural element being constructed, the disposition of reinforcement, and taking full account of the environment to which it will be subjected.

The minimum cement contents and maximum water/cement ratios of designed mixes shall be as given in Table 14.1. In the event of sulphate exposure precautions requiring lower cement content than those required for normal conditions the latter requirements shall prevail.

The maximum cement content in any mix shall not exceed 500 kg/m² for normal structures and 425 kg/m² for liquid retaining structures.

In all cases of mix proportioning, the added water shall be included with due allowance for the moisture contained in the aggregates and shall be the minimum consistent with the workability requirements.

<table>
<thead>
<tr>
<th>Type of Structural Element</th>
<th>Exposure Conditions (BS 8110)</th>
<th>Minimum Cement Content (kg/m³)</th>
<th>Maximum Aggregate Size</th>
<th>Maximum Water/ Cement Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>40 mm</td>
<td>20 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>Liquid Retaining Structures, Shafts and Tunnel Linings</td>
<td>Severe</td>
<td>295</td>
<td>325</td>
<td>356</td>
</tr>
<tr>
<td>All Foundations and Buried Structures</td>
<td>Moderate</td>
<td>270</td>
<td>300</td>
<td>340</td>
</tr>
<tr>
<td>Building Super-Structure</td>
<td>Moderate</td>
<td>270</td>
<td>300</td>
<td>340</td>
</tr>
</tbody>
</table>
**SPECIFICATIONS CONCRETE**

### Additional Requirements when Exposed to Sulphate Conditions (All Structural Concrete)

<table>
<thead>
<tr>
<th>Concentration of Sulphates (expressed as SO₃)</th>
<th>Minimum Cement Content (kg/m³)</th>
<th>Maximum Aggregate Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>In soil (Total SO₃)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parts per 100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤0.2</td>
<td>≤ 30</td>
<td>No Special Precautions</td>
</tr>
<tr>
<td>0.2 - 0.5</td>
<td>30 - 120</td>
<td>OPC 300</td>
</tr>
<tr>
<td>0.5 - 1.0</td>
<td>120 - 250</td>
<td>SRPC 250</td>
</tr>
<tr>
<td>1.0 - 2.0</td>
<td>250 - 500</td>
<td>OPC Not permitted</td>
</tr>
<tr>
<td>&gt; 2.0</td>
<td>S500</td>
<td>SRPC 340</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Aggregate Size</th>
<th>OPC - Ordinary Portland Cement</th>
<th>SRPC - Sulphate Resisting Portland Cement</th>
</tr>
</thead>
</table>

**Strength**

The characteristic strength of concrete means that value of the 28 day cube strength below which 5% of all possible test results would be expected to fall.

The relationship between grade of the concrete and its characteristic strength shall be as given in BS 5328. The grade of concrete to be used in particular locations shall be as given in Table 14.2 unless noted otherwise on the drawings.

### Table 14.2 Concrete Strength Requirements

<table>
<thead>
<tr>
<th>Location</th>
<th>Maximum Coarse Aggregate Size (mm)</th>
<th>Grade of Concrete (BS 5328)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinding Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- General Structures</td>
<td>20 or 40</td>
<td>C15P</td>
</tr>
<tr>
<td>- Liquid Retaining Structures</td>
<td>20</td>
<td>C20P</td>
</tr>
<tr>
<td>Blinding Concrete - Sulphate Condition</td>
<td>20</td>
<td>C25P</td>
</tr>
<tr>
<td>Substructure thickness less than 400 mm</td>
<td>20</td>
<td>C30P</td>
</tr>
<tr>
<td>Substructures, walls and slabs more than 400 mm</td>
<td>20 or 40</td>
<td>C30D</td>
</tr>
<tr>
<td>Superstructures, Normal Concrete</td>
<td>20</td>
<td>C30D</td>
</tr>
<tr>
<td>Liquid Retaining Structures</td>
<td>20</td>
<td>C30A</td>
</tr>
<tr>
<td>Fine Concrete</td>
<td>10</td>
<td>C30D</td>
</tr>
<tr>
<td>Precast Concrete</td>
<td>10 or 20</td>
<td>C30D</td>
</tr>
</tbody>
</table>

In the above table suffix P means a prescribed design mix complying with the requirements of BS 8007.

Mixes
The principal basis of control shall be by
specification or other approved methods, for the
requirements set out in this Specification.

For the purpose of determining the design
mean strength of the concrete a margin shall be
added to the characteristic strength for the
particular grade of concrete. This design
margin shall be assessed on the degree of
control reasonably to be expected in the
manufacture of the concrete and shall not be
less than 5N/mm² nor less than 1.64 times the
standard deviation. Until such time as the
standard deviation has been assessed the
margin shall be not less than 7,50N/mm².

details of the designed mixes shall be
forwarded immediately to the Engineer for his
approval.

(b) Prescribed Mixes
Proportions for the several grades of concrete
shall conform to the requirements of Tables
14.3 and 14.4.

(d) Chloride Content
The total chloride content of the concrete mix
shall comply with the requirements of BS 8110:
Part 1: Section 6.

Quality Control
The principal basis of control shall be by
comparison of the results of the compression
cube tests at 28 days, except for small
quantities of concrete whose strength can be
otherwise derived and which is permitted for
use by the Engineer. 40 sample cubes shall be
made initially in eight samples each day for five
days of concreting and thereafter one sample
der 25 m³ of concrete but not less than one
sample for each day’s concreting.

Where materials are of an unfamiliar grading or
type, compression cube tests shall be carried
out at 7 days and adjustments made in advance
of the main control methods outlined above.

Cube test results will be examined individually
in 10 consecutive sets of four and the standard
deviation and mean strength of each set
calculated. The concrete mix proportions will
only be acceptable if all of the following
requirements are complied with:-

(i) Not more than two results in 40 are less
than the characteristic crushing strength.
(ii) No value of the average for any set of four
results is less than the characteristic strength
plus one-half of the design margin (Clause
14.2).
(iii) When 40 results have been obtained and
the mean strength and standard deviation are
calculated, the mean strength minus 1.64 times
the standard deviation shall be greater than the
characteristic strength.

Where the results do not conform to the above
requirements the following action shall be
taken:-

- Adjustments to the mix shall be made to
obtain the strength required.
- In the case where any result is less than 80%
of the characteristic strength the structural
implications shall be considered and action
taken as ordered by the Engineer (as provided
for in Clause 14.5).

For those Prescribed Mixes required to be
tested, requirements (i) and (ii) only will be
applicable.

Production
Aggregates and cement shall be proportioned
by weigh-batching, and water shall be
proportioned by volume. Subject to the prior
approval of the Engineer volume-batching of
aggregates may be used for small sections of
works, but volume batching of cement will in no
case be accepted. The Contractor may,
however, so proportion the mix that each batch
shall use a whole bag or bags of cement, the
weight of which is known precisely. Where
permission has been given for volume batching
of aggregates, all gauge boxes shall be accurate
and due allowance shall be made for the
bulking of the aggregates in assessing the
correct volume to be used.

The aggregates and the cement shall be
thoroughly mixed in a clean mechanical mixer
for a period of time agreed with the Engineer
and the water added on the basis of the
approved design.

The amount of water added shall conform to
the requirements of Clause 14.2.

Batching mixing machines shall comply with the
requirements of BS 1305. They shall be
provided in such numbers and of such capacity
as to ensure a continuous supply of freshly
mixed concrete at all times during construction.

Continuous mixing machines shall be used only
with the written permission of the Engineer.

SPECIFICATIONS
Not less than 30 days prior to the installation of
the Contractor’s plant and equipment for
processing, handling, transportation, storing
and proportioning ingredients, and for mixing,
transporting and placing concrete, the
Contractor shall submit drawings for approval
by the Engineer, showing proposed general
plant arrangements, together with a general
description of the equipment proposed for use.

After completion of installation, the operation of
the plant and equipment shall be subject to the
approval of the Engineer.

Where these Preambles, the Bills of Quantities
or the Drawings require specific procedures to
be followed, such requirements are not to be
construed as prohibiting use by the Contractor
of alternative procedures if it is approved by the
Engineer, prior to use of such alternatives.

Approval of plant and equipment or their
operation, or of any construction procedure,
shall not operate to waive or modify any
provisions or requirements contained in the
Preambles governing the quality of the
materials of the finished work.
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### Table 14.3 Prescribed Mixes - Mass of Dry Aggregate to be Used With 100 kg of Cement

<table>
<thead>
<tr>
<th>Grade of concrete</th>
<th>Nominal maximum size of aggregate (mm)</th>
<th>40</th>
<th>20</th>
<th>14</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workability</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Range for standard sample (mm)</td>
<td>50-100</td>
<td>80-170</td>
<td>25-75</td>
<td>65-135</td>
</tr>
<tr>
<td>C7.5P</td>
<td>kg kg kg kg</td>
<td>1080</td>
<td>920</td>
<td>900</td>
<td>780</td>
</tr>
<tr>
<td>C10P</td>
<td>kg kg kg kg</td>
<td>900</td>
<td>800</td>
<td>770</td>
<td>690</td>
</tr>
<tr>
<td>C15P</td>
<td>kg kg kg kg</td>
<td>790</td>
<td>690</td>
<td>680</td>
<td>580</td>
</tr>
<tr>
<td>C20P</td>
<td>kg kg kg kg</td>
<td>660</td>
<td>600</td>
<td>600</td>
<td>530</td>
</tr>
<tr>
<td>C25P</td>
<td>kg kg kg kg</td>
<td>560</td>
<td>510</td>
<td>510</td>
<td>460</td>
</tr>
<tr>
<td>C30P</td>
<td>kg kg kg kg</td>
<td>510</td>
<td>460</td>
<td>460</td>
<td>400</td>
</tr>
</tbody>
</table>

N/A not applicable
Table 14.4 Prescribed Mixes - Percentage by Mass of Fine Aggregate to Total Aggregate

<table>
<thead>
<tr>
<th>Grade of concrete</th>
<th>Nominal maximum size of aggregate (mm)</th>
<th>40</th>
<th>20</th>
<th>14</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workability</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>C7.5P } C10P } C15P }</td>
<td>30-45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C20P } C25P } C30P }</td>
<td>Grading zone 1</td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>30</td>
<td>35</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

N/A implies not applicable

Notes on the use of Tables 14.3 and 14.4

NOTE 1. The proportions given in the tables will normally provide concrete of the strength in N/mm² indicated by the grade except where poor control is allied with the use of poor materials.

NOTE 2. For grades C7.5P, C10P and C15P a range of fine-aggregate percentages is given; the lower percentage is applicable to finer materials such as zone 4 sand and the higher percentage to coarser materials such as zone 1 sand.

NOTE 3. For all grades, small adjustments in the percentage of fine aggregate may be required depending on the properties of the particular aggregates being used.

NOTE 4. For grades C20P, C25P and C30P, and where high workability is required, it is advisable to check that the percentage of fine aggregate stated will produce satisfactory concrete if the grading of the fine aggregate approaches the coarser limits of zone 1 or the finer limits of zone 4.

Cement

Cement shall, as a minimum, meet the requirements of CEMI-32.5; CEMII-32.5 or CEMIV-32.5 in accordance with Kenya Standard KS 1725 Part 1 (Composition, Specifications and conformity criteria for common cements) and Part 2 (conformity Evaluation). Concrete for power floated floors shall as a minimum meet the requirements of CEMI-42.5, CEMII-42.5 or CEMIV-42.5. Approval to the use of cement manufactured to the above standards or any other approved standards shall be subject to the Contractor demonstrating that the resulting concrete shall meet the strength requirements as given in the drawings and the relevant sections of the Concrete Specifications.

Pulverised-fuel ash shall have a maximum colour index of 6 (Colour comparator disc reference No. 296570) when measured using the Lovibond Colour Comparator system as recommended in BS 3892: Part 1 Appendix H, Clause H8.

Cement shall be fresh when delivered to Site and the consignments shall be used in the order of their delivery. The Contractor shall mark the date of delivery on each consignment and each consignment shall be stored separately and in such manner as to be easily accessible and identifiable.

No cement in bags or other containers shall be used unless these and the manufacturer's seals are intact at the time of mixing.

If the cement is delivered in bags it shall be stored in a waterproof shed or building at a temperature of not less than 8°C and the bags shall be placed on dry boards above the floor to prevent deterioration or contamination from any cause.

Bulk cement may be used provided it is stored in an approved container.

The Contractor shall not use cement which has hardened into lumps, but subject to removal of the lumps by screening, the Engineer may allow such cement to be used in non-structural concrete mixes.

Cement of different types shall be kept separate in storage and shall not be mixed together in the production of concrete.

Aggregates

The Contractor shall investigate the proposed aggregate sources in detail and shall submit a comprehensive report with technical information and data which shall include the following:

(a) Location. Only Sources equipped with facilities adequate for the production of the materials as specified and in such quantities as shall be required for the prompt execution of the Contract shall be approved.

(b) Petrology of sources and possible or likely variability during the Contract period.

(c) Method of production

(d) Schedule of available and proposed processed aggregates by size, including details of actual screen sizes to produce each aggregate.

(e) Test data as applicable for each aggregate type and size based upon representative samples and tested in accordance with the appropriate British Standards.

(f) A detailed statement of the aggregate proposed for use in each grade of concrete.

Samples of all aggregate, including fine aggregates and sand shall be submitted to the Engineer for his approval. All samples shall be taken in accordance with BS 812 and shall weigh not less than the minimum weight indicated on Table 1 of that Standard.

The Contractor shall produce with each consignment or at intervals directed by the Engineer a certificate signed by the Supplier, or other approved analyst, giving fully detailed chemical and physical properties of all aggregates together with a sieve analysis carried out in accordance with the appropriate British Standard.
Any changes in the particulars of the aggregates which occur during the course of the Contract must be notified to the Engineer without delay.

The aggregates shall be stored on Site in separate stockpiles so arranged as to prevent the intermingling of the various aggregate sizes. The stockpiles shall be suitably protected to prevent contamination of the aggregates from the ground, rubbish or by leaves, dust or other windblown materials.

Aggregates shall conform to the requirements of "Acceptable Standards" of Table 14.8.

Building sand for mortar and similar uses and aggregates for concrete shall comply to BS 882 and shall be perfectly clean and free from all foreign matter and shall not consist of, nor contain argillaceous limestone or shells.

Where the nominal size specified exceeds 37.5 mm the grading shall be subject to the Engineer’s approval or in accordance with his directions.

Unless otherwise agreed with the Engineer, single-sized aggregates shall be used in batching and mixing concrete.

The following impurities in both fine and coarse aggregates shall not exceed the limits stated in the following clauses:

- The total chloride content of the concrete mix arising from the aggregate together with that from any admixtures and any other source, expressed as a percentage of chloride ion shall not in any circumstances exceed 0.1%.

- Note: Marine aggregates and some inland aggregates contain chlorides. Both should be selected carefully and marine aggregates necessitate efficient washing to achieve the 0.1% chloride ion limit. Wherever possible, the total chloride content should be calculated from the mix proportions and the measured chloride content of each of the constituents.

Concrete made with some aggregates exhibit Alkali-Silica Reaction (ASR). This phenomenon is particularly detrimental in structures subject to wetting and their use will not be allowed in such structures.

Prior to acceptance of an aggregate as inert to alkali reaction the report of a qualified geologist, appointed by the Engineer on the suitability or otherwise of materials shall be obtained following examination of all types of material that the proposed sources will yield during the course of the contract. The Engineer may require that samples be taken from boreholes and for large contracts or contracts extending over a long period then more than one report is to be obtained.

The Engineer may order further tests to be carried out on the aggregates proposed by the Contractor for the structures in connection with this Contract before permission is given to use the aggregates proposed by the Contractor.

Where allowed by the Engineer to use reactive or potentially reactive aggregates in certain structures the Contractor shall take all suitable measures to prevent deterioration of concrete due to alkali-silica reaction. Such measures shall include the use of cement with an acid soluble equivalent of sodium oxide content (Na2 O + 0.658K2 O) of less than 0.6%. The reactive alkali content of the concrete mix shall be in no circumstances exceed 3 kg/m².

The Alkali-Silica Reaction (ASR) in hardened concrete is also affected by the water-cement ratio. Therefore, where ASR aggregates are used, with the permission of the Engineer, the water-cement ratio shall be kept to a minimum (in the region of 0.4).

Aggregates required for use in the construction of concrete water retaining, water excluding and other similar structures shall have a low drying shrinkage and the water absorption shall not exceed 3%.

The absorption of the aggregates shall be measured in accordance with BS 812, Part 2.

Aggregates of rounded shape or otherwise capable of producing a concrete of good workability with the minimum addition of water shall be preferred.

Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Engineer such contamination has taken place it shall be removed by an approved means or otherwise the aggregate shall be rejected.

For mass concrete, in order to improve the workability of the mix, dust or flour resulting from crushing the aggregate, may subject to test, be included in controlled quantities to supplement the fine aggregate.

Except where aggregates have been otherwise specified on the Drawings the grading of aggregates shall be as follows:

(i) Coarse Aggregate:

- (a) 10 mm max. size, graded, for all “fine” concrete.
- (b) 20 mm max. size, graded, for all reinforced concrete in beams and for walls and slabs not greater than 400 mm thick.
- (c) 40 mm max. size, graded, for all reinforced concrete walls and slabs in excess of 400 mm thick.

(ii) Fine Aggregate:

- (a) Where aggregates conforming to Zones 2 or 3 of BS 882 are available they shall be used.

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(b) For Prescribed Mixes, Zones 1, 2, or 3 aggregates only shall be used.

Fine and coarse aggregates shall be as defined by and be of the quality and nature required by BS 882. In addition they shall be chemically inert to alkali reaction.

Water

The Contractor shall supply all water, make all arrangements and pay all charges in respect of such supply. Where water can be obtained from a public water supply it shall be used.

Where water cannot be obtained from a public supply it shall be tested in accordance with BS 3148 and if necessary shall be treated to assure compliance therewith.

Water for washing and curing shall be such that it will impair neither the strength of the finished concrete nor its appearance.

Admixtures

(i) General: The quantity and method of using admixture’s shall be in accordance with the manufacturer’s recommendations and in all cases shall be subject to the approval of the Engineer. Unless otherwise specified or approved by the Engineer, an admixture shall comply with one of the following:

- BS 1014 (Pigments for Portland cement and Portland cement products).
- BS 5075 (Concrete admixtures except chloride based admixtures).

In all cases the Contractor shall provide the following information for the Engineer’s approval:

- (a) the quantity to be used, in kilograms per kilogram of cement and in kilograms per cubic metre of concrete;
- (b) the detrimental effects caused by adding a greater or lesser quantity in kilograms per cubic metre of concrete;
- (c) the chemical name(s) of the main active ingredients;
- (d) whether by the Engineer, the Contractor shall demonstrate the action of an admixture by means of trial mixes.

(ii) Calcium chloride. The use of calcium chloride in any form is prohibited.

Control of Alkali-Silica Reaction

The risk of cracking and expansion due to alkali-silica reaction shall be minimised by compliance with the specification and guidance notes set out in Technical Report No. 30 of the Concrete Society, Framework Road, Wexham, Slough, Berkshire SL3 6PJ, UK (tel. +44 1753 662226, fax. +44 1753 662126).
14.3 REINFORCEMENT

Steel

Reinforcement shall be:

(a) Plain round mild steel or High Yield steel bars conforming to BS 4449.

(b) Cold worked steel bars conforming to BS 4449: 1988.

(c) Fabric reinforcement made of cold drawn high tensile bars conforming to BS 4483.

The Contractor shall obtain from his suppliers certificates of the mechanical and physical properties of the reinforcement and shall submit them to the Engineer for approval, except where reinforcement has been supplied by the Employer. The frequency of sampling and the method of quality control shall be in accordance with Table 4 and Clause 20 respectively of these British Standards. All high yield and cold worked bars (except in welded fabric reinforcement) shall be deformed bars complying with Classification Type T2 for bond strength in accordance with BS 4449. Where galvanised reinforcement is specified, galvanising shall comply with the requirements of BS 729, Part 1.

Storage

Reinforcement shall be stored on Site under cover and supported clear of the ground and in such manner as to make identification easy. Supports shall be such that distortion of the steel is avoided and contamination and corrosion prevented.

Bending and Fixing

The Contractor shall provide on Site facilities for cutting and bending reinforcement whether he is ordering his reinforcement bent or not and shall ensure that a token amount of straight bar is available on Site for bending as and when directed by the Engineer.

Reinforcement shall be wire brushed and cleaned at the Contractor's expense, before and/or after it is placed in position, if required by the Engineer.

The bars shall be cold bent in strict accordance with the drawings and the Contractor shall be responsible for the accuracy of the bending. Bending dimensions shall be worked to the tolerances indicated in BS 4466 and BS 8110 table 3.28. Bars in which any errors in bending are beyond the limits of the foregoing tolerances shall be replaced at the Contractor's cost by correctly bent new bars, or, may be straightened and rebent cold subject to the Engineer's prior approval. Any discrepancy or inaccuracy found in the drawings shall be notified to the Engineer immediately.

After bending, reinforcement shall be securely bundled and labelled with weather-proof tags or shall be marked with other approved signs by which it can readily be identified.

Before assembling or fixing the reinforcement the dimensions to which it has been bent shall be checked by the Contractor against the drawings.

The reinforcement shall be fixed in strict accordance with the drawings as regards cover, spacing and position, and suitable precautions shall be taken by the Contractor to prevent the displacement of reinforcement during the placing and compaction of concrete.

During concreting a competent steel fixer must be in attendance to adjust and correct the positions of any reinforcement which may be displaced. The vibrators are not to come into contact with the reinforcement.

Where required to support and retain the reinforcement in its correct position the Contractor shall provide templates, stools or other supports at his own cost. He shall allow for cutting to correct length all corner lacer bars included in the bar schedules as standard lengths.

Precast concrete support blocks for reinforcement shall be manufactured from Grade C30D "fine" concrete to ensure the correct cover thickness. They shall be well cured before use and carefully stored on Site to avoid contamination. Plastic and metal supports, chairs, etc. may be used and shall be subject to the Engineer's prior approval.

In the case of mild steel, a lap of not less than 40 diameters of the smaller bar shall be provided at the junction of two bars for which the lap is not specifically detailed on the Drawings and, in the case of High Yield steel, a lap of not less than 50 diameters.

All intersections of bars in walls and slabs and all connections between binders or links and main bars in columns or beams shall be tied with soft iron wire ties or with fixing clips which shall not be allowed to make contact with the formwork or to project materially into the specified cover.

Unless permitted by the Engineer, welding of reinforcement at intersections or for the joining of bars is prohibited. Where permission is granted, welding shall be carried out in accordance with the recommendations of the Institute of Welding for the welding of reinforcing bars for reinforced concrete construction.

When fixed reinforcement is to be left exposed for more than eight weeks, it shall be thoroughly cleaned and painted with neat cement grout.

Where galvanised reinforcement is used any damage suffered by galvanising shall be made good by the application of an approved galvanising formulation, before concrete placing is commenced.

No concreting shall be commenced until the Engineer has inspected the reinforcement in position and until his approval has been obtained and the Contractor shall give adequate notice of his intention to concrete.

Coupers

Coupers for reinforcement shall be either Standard Swaged Splices or Type II Alpha Coupers manufactured by CCL Systems Limited, Cabco House, 201 Elland Road, Leeds, West Yorkshire, LS11 8BH (tel: +44 1132 701221, fax: +44 1132 760138, tx: 55243 CCLSYS G) or similar approved. Where bars of different diameters are to be joined a CCL Reducer Sleeve or similar shall be used.

Coupers shall be suitable for the type and size of reinforcing bars and shall be capable of developing 115% of the characteristic strength of the smaller of the reinforcing bars being joined in both tension and compression. Coupers shall be installed in accordance with the manufacturer's recommendations. Square twisted reinforcing bars shall not be used with couplers.

14.4 FORMWORK

Requirements

The term "formwork" shall be taken to include centring, formwork, strutting, bracing and the like.

When called upon to do so by the Engineer the Contractor shall submit his formwork proposals for checking and approval by the Engineer in advance of the concreting.

Formwork shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional, wind or other loads likely to be imparted to it, without producing deformation of the finished concrete in excess of the tolerances outlined in Clause 14.4 and Table 14.5.

All formwork shall be sufficiently tight, without plumbing, to prevent loss of grout during the vibration of the concrete. When required by the Engineer joints between formwork facing boards shall be sealed with foam rubber, sealing strips or other approved material. A foam rubber or polyurethane strip shall be provided around the tops of all walls and columns before affixing the forms for the next lift.

Faces of formwork shall be clean, free from projecting nails, adhering grout and other imperfections or defects which would prevent the specified surface finish from being attained. They shall be treated with approved mould oil before positioning. Great care shall be
exercised to prevent reinforcement or steelwork from being contaminated by the oil during erection of the formwork.

Formwork, which as a result of prolonged use or general deterioration does not, in the opinion of the Engineer, conform to the particular requirements set out in this clause, shall not be used.

Through-bolts or ties will not be permitted in liquid-retaining structures. The Contractor shall use only such bolts or ties as are capable of being removed in whole or in part so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement.

Beam soffits shall be erected with an upward camber of 5 mm for each 3 metres of span.

Top formwork shall be counterweighted or otherwise anchored against flotation.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air, and shall be capable of being sealed, subsequently to prevent the loss of grout. The use of polystyrene blocks for the forming of holes, sinkings, etc. will not be allowed except by express permission of the Engineer.

On all external edges risers of the concrete 20 mm chamfers shall be formed.

Openings for inspection of the inside of beam, wall, column and similar formwork and for cleaning-out purposes shall be formed so that they can conveniently be closed before the placing of concrete.

All props shall be supported on adequate sole plates and shall not bear directly on or against concrete. They shall be capable of being released gently and without shock from the supported formwork. No appliance for supporting the formwork shall be built into the permanent structure without the Engineer’s prior approval. Props for upper level support shall be placed directly over those at lower levels, and the lowermost props shall bear upon work sufficiently mature to carry the load.

Formwork shall be such as to allow for its removal without damaging the concrete, and in the case of suspended floors, for the removal of the beam sides and slab soffits without disturbing the beam-bottom boards and their props.

Before concreting, the areas which are intended to receive the concrete shall be cleaned by jetting with compressed air, and all water and extraneous material removed.

Where timber is used for formwork it shall be properly cured, free from warp, straight, clean and free from loose knots.

Where metal forms are used for formwork they shall be of the type strengthened by intermediate ribs or cross bracing.

Moving formwork may be used where in the opinion of the Engineer it is appropriate.

Sawn Formwork

Sawn formwork shall produce an ordinary standard of finish consistent with normal good practice for use where the face of the finished concrete will not be exposed. The face in contact with the concrete shall consist of sawn timber boards, sheet metal or other approved material.

Table 14.5 Tolerances of Dimensions for Finished Concrete

<table>
<thead>
<tr>
<th>Items</th>
<th>Tolerances (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall dimensions and levels generally</td>
<td>±5</td>
</tr>
<tr>
<td>Flatness of floor surface after floating and levelling.</td>
<td>±3 mm in 3 m</td>
</tr>
<tr>
<td>Variation from level or grades indicated on the drawings.</td>
<td>-15 mm</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Local variation in levels on floors</td>
<td>±1 mm in 500 mm</td>
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<tr>
<td>Column sizes</td>
<td>±5</td>
</tr>
<tr>
<td>Beam sizes</td>
<td></td>
</tr>
<tr>
<td>Wall sizes</td>
<td></td>
</tr>
<tr>
<td>Vertical lines out of plumb</td>
<td>5 mm ± 15 mm in every 15 m height</td>
</tr>
</tbody>
</table>

Except that in the case of Sawn Formwork the dimensions of the finished concrete shall be not less than those shown on the drawings.

SPECIFICATIONS CONCRETE

Wrought Formwork

Wrought formwork for use on exposed faces and water retaining faces shall produce a high standard of finish consistent with the best practice. The face in contact with the concrete shall consist of wrought and thicknessed boards tongued and grooved of not less than 30 mm finished thickness, framed plywood or metal panels or other approved material. Joints between boards and/or panels shall be arranged in a uniform pattern.

Special Wrought Formwork

Special wrought formwork shall provide the highest standard of finish where the face of the finished concrete is to form a particular feature. The face in contact with the concrete shall consist of large smooth sheets, unless otherwise specified, arranged in an approved uniform pattern, with joints coinciding with possible architectural features, sills, window heads, or changes in direction or surface. Accurate alignment of all joints shall be maintained. Wrought boarding and standard steel panels shall not be used unless specially faced.

Tolerances

Unless otherwise indicated on the drawings, the tolerances of the finished concrete with respect to the dimensions shown on the drawings shall not exceed the limits set out in Table 14.5.

Striking and Removal

The recommendations set out in Table 14.6 are given as a minimum requirement for striking formwork:-
The removal of props to slabs and beams shall, if directed by the Engineer, be subject to satisfactory results of the relevant 7 day cube crushing tests.

The above striking times are for normal conditions and before deciding on the actual time for each case, the Contractor shall consider and extend the period as tabled if:-

(a) the span of the structural member under consideration exceeds 6 metres for beams and 3 metres for slabs. An additional period of one day for each 500 mm of additional span shall then be allowed;

(b) the dead load of the structural member under consideration forms a large proportion of the total design load;

(c) constructional loads coming on to the structural member under consideration are being placed soon after the concreting operations and these loads form a large proportion of the total design load;

(d) the setting of the concrete has been retarded for any reasons;

(e) the temperature falls below 8°C. An additional period of half a day shall be added for each day on which the temperature falls below 8°C. For temperatures falling below 3°C the additional period to be added shall be one day for each day on which the temperature falls below 3°C;

(f) any combination of the above points and other considerations which would call for such a precaution to be taken.

(g) the span concerned is part of a continuous spanning system and the adjacent two spans have not been cured sufficiently.

Information regarding paragraph (b) above will be supplied by the Engineer; any other design information relevant to the above shall be obtained by the Contractor from the Engineer.

### 14.5 CONCRETING

#### Requirements

The finished concrete shall be dense, durable, impervious to the ingress of water, free from cracks and honeycombing, and resistant to wear and mild chemical attack. Special concretes will be the subject of their own particular sections of Special Concrete.

### Transporting

Concrete shall be transported to the place of final deposit by approved means.

Barrows, spades and other equipment used in the process of transporting concrete shall be thoroughly cleaned before each day’s work or after a long interruption and they shall be free from hardened concrete.

Concrete shall be transported as soon as possible after mixing, by methods which will prevent the segregation, loss or contamination of the ingredients.

Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for pumping the concrete, the pump manufacturer’s recommendations shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply. The Contractor shall provide adequate alternative arrangements for transporting the concrete in case of a breakdown of the pumping equipment. (See also Clause 14.7).

Wherever transport of concrete is interrupted for any length of time (periods of over half an hour shall be treated as such) the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned. These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardened concrete. All washwater used shall be discharged outside the formwork and clear of any freshly placed concrete.

### Placing and Compaction

No concrete shall be placed until the Contractor has obtained approval to do so from the Engineer. When the Contractor intends to place concrete he shall inform the Engineer in sufficient time to enable him to inspect the reinforcement, formwork and surface on which the concrete is to be placed and the Contractor shall provide all facilities for such inspection.

This approval shall be sought by presenting two copies of the completed “Structural Concrete Approval Form” (SCAF) to the Engineer’s Representative at least 24 hours before the intended time of concreting. (See sample on page titled “STRUCTURAL CONCRETE APPROVAL FORM (SCAF)”)

Concrete shall be placed within 30 minutes of mixing, to uniform level, in layers not exceeding 500 mm deep in such manner as to avoid segregation, and each layer shall be compacted by means of approved vibrators to form a dense material free.
from honeycombing and other blemishes. Compaction by hand may be used only with the prior approval of the Engineer.

At least one internal vibrator shall be operated for every four cubic metres of concrete placed per hour and at least one spare vibrator for every three shall be maintained on Site in case of breakdown during concreting operations.

Vibration time, the effective radius and other vibration characteristics shall be in accordance with the vibrator manufacturer's recommendations.

If internal vibrators are used, they shall be withdrawn immediately water or a thin film of mortar begins to appear on the surface of the concrete. Withdrawal shall be carried out slowly to avoid cavitation.

Internal vibrators shall not be inserted between layers of reinforcement less than one and one half times the diameter of the vibrators apart. Contact between vibrators and reinforcement and vibrators and formwork shall be avoided.

Vibrators shall not be used to move concrete from place to place in the formwork.

Where two distinct batches of concrete, placed at different periods of time and forming part of the same concreting operation are required to be formed monolithically with each other, the more mature concrete shall be penetrated by the vibrator to a sufficient depth to effect plastic movement between the two batches. Where the concrete does not respond to the action of the vibrator, it shall be deemed to have set, and no further disturbance will be permitted. Unless otherwise instructed by the Engineer the condition shall be treated as for a "stoppage of work" and the marrying up of the two concretes shall be effected only when both concretes have properly set.

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If external vibrators are used, the formwork shall be strong enough to withstand the forces of vibration.

Temporary or permanent stoppages of work shall be made only against stop ends (Clause 14.5).

Unless otherwise specified, before placing new concrete against concrete which has already hardened, the face of the older concrete shall be prepared by the removal of any laitance and loose aggregate, and shall be cleaned by a jet of compressed air.

When displacers are permitted to be used they shall be so placed that no displacer is within 300 mm of any finished face or within 500 mm of any other displacer. On completion of any lift, displacers shall be so arranged that they project for half their height above the surface.
### STRUCTURAL CONCRETE APPROVAL FORM (SCAF)
(To be filled in duplicate before any pour)

**Contract Details**

<table>
<thead>
<tr>
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<table>
<thead>
<tr>
<th>Contractor</th>
<th>Site Engineer</th>
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**Section and Concrete Details**

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<table>
<thead>
<tr>
<th>Level</th>
<th>Date / Time of Request</th>
<th>Date / Time of Pour</th>
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<tbody>
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Concrete Class______
Mix: Design / Nominal (delete one) Batching: Site / Ready Mix (delete one)

**Check List**

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<td>Chairs / Links, etc.</td>
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<td>Reinforcement Cover</td>
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<tr>
<td>Shutters / Stop ends</td>
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<td>Shutter Props</td>
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<td></td>
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<tr>
<td>Tie Bolts</td>
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<tr>
<td>Plumbness / Slope</td>
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<td>Dimensions</td>
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<td>Line and Level</td>
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<tr>
<td>Preparation hacking of joints</td>
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<td>Water Stops</td>
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<td>Moulds for Cubes</td>
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</tr>
<tr>
<td>Materials for Curing</td>
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<td></td>
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<tr>
<td>Any other checks (specify)</td>
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<td></td>
</tr>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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</tr>
</tbody>
</table>

**Approval**

- [ ] Approved
- [ ] Not Approved

Date: __________________ Signature: __________________

**Note:**

Approval by the Engineer or his Representative does not relieve the Contractor of any of his contractual obligations.
Concreting in Deep Lifts

(i) Limitations

Any height exceeding 2.5 m from which concrete is poured into formwork to form sections of wall will be considered within the terms of this Clause.

Concrete in columns may be placed to a height of 4.0 m with careful placing and vibration and satisfactory results. Where the height of the column exceeds 4.0 m suitable openings must be left in the shutters so that the maximum lift is not exceeded.

Deep lift construction will not be permitted where the reinforcing bars are to be placed closer than 100 mm to one another in any direction or, where the clear width at the point of admitting the concrete between one layer of reinforcement and another (or in the case of singly reinforced walls between reinforcement and formwork) is less than 200 mm.

The method shall only be used where trial sections revealed that, in the Engineer’s opinion it can be satisfactorily employed, in which case the requirements of this Specification shall apply except where they are in conflict with the requirements of this particular clause, when the latter shall prevail.

(ii) Concrete

In order to prevent segregation of aggregates, concrete mixes shall be designed for increased cohesion, or, where suitable, on a gap-graded basis. The use of approved admixtures may be made to achieve this end (14.2).

At the same time, the mix shall be such as to limit the amount of bleeding in the concrete, and where in the opinion of the Engineer the quantity of free water rising to the surface is excessive, the mix shall be corrected before further concreting is undertaken.

In order to offset any increase in the water-cement ratio at the upper levels, the Engineer may require the concrete mix to be modified for the upper depostitions.

A slump of 80 mm shall not be exceeded.

(iii) Reinforcement

In order that reinforcement is not distorted or displaced during construction as a result of it being used for gaining access in or out of the formwork, all intersections of vertical and horizontal steel shall be properly fastened.

All obstructions caused by spacer blocks or chairs shall be eliminated so as to permit an unobstructed passage for the concrete to the bottom of the formwork. The Contractor may use sliding timber spacers instead of fixed concrete or plastic spacer blocks to position the reinforcement.

(iv) Formwork

In view of the high pressures to be expected from this form of construction extra attention shall be paid to the strength and stability of the formwork, to the prevention of loss of grout, and to the prevention of displacement of adjacent panels.

The use of through-bolts and other accessories which might interfere with the free passage of concrete between and around the reinforcement shall be reduced to a minimum by the use of properly designed formwork.

(v) Concreting

Particular attention shall be paid to the concreting of the initial sections at the bottom of the formwork to prevent segregation caused by rebound from the hard surface of the kicker, base and/or lower sections. The initial depostitions shall therefore be made by using trunking methods, or by placing the concrete through openings formed in the sides of the formwork. Such openings shall not be higher from the hard surface than 2.5m.

In order to reduce differential settlement, and consequently, cracking between two sections of wall, the reinforcing bars are to be placed at equal distances apart, and formwork (pumps, vibrators, buckets, etc.) shall be used, or, where distance does not exceed 1.5 m into the formwork. A sufficient number of such hoppers shall be provided, and/or they shall be capable of movement along the length of the formwork, to enable the concrete to be placed in contiguous heaps at the base of the pour. Such heaps shall not exceed 460 mm in height.

Where excessive bleeding is in evidence, the excess water shall be removed before placing further concrete.

(vi) Compaction

Compaction shall be carried out where possible by manual operation of poker vibrators within the formwork. Where this is not possible poker vibrators shall be suspended in sufficient numbers to ensure uniform compaction along the length of wall receiving the concrete, without the need for their withdrawal and re-insertion. The means of suspension shall be such that the vibrators may be progressively and systematically lifted as the concreting proceeds to ensure that every section of placed concrete is married into adjacent and underlying sections.

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The use of vibrators to reposition deposited concrete is prohibited. Surface vibrators attached to the formwork may be used only to supplement the main means of compaction.

Continuous Concreting

Where the Contractor desires to use continuous concreting method in large sections (rafts and walls), he shall submit a written request to the Engineer for approval. In the request he shall attach details which shall include but not be limited to the following:-

- Total amount of concrete to be placed in the shift.
- Stock of approved concrete materials on site.
- Capacity of the batching plant.
- Number and type of truck mixers to be deployed for the exercise and movement logistics.
- Number of skilled and other manpower to be deployed for the exercise in shifts.
- Number and capacity of plant to be used in placing concrete (pumps, vibrators, buckets, etc.).
- Method(s) of monitoring and dealing with the heat of hydration.
- Details of protection against rain and floodwaters and how to cope with it.

The Engineer shall consider the above details and other parameters (e.g. weather, satisfactory records of cube test results, availability of adequate working sections where reinforcement placement and the necessary formwork have been approved etc.), before making his decision. The Engineer may order that additional concrete cube moulds be made available as well as arrangements be made for cube crushing with an approved laboratory to cope with the increased demand.

The Engineer may order that the concreting works be stopped immediately if in his opinion the quality of the works is threatened for whatever reason.

Hot Weather Concreting (for temperatures above 20 Degrees Centigrade)

Concreting shall not be permitted if its temperature at placing is in excess of 35°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Engineer:-

(i) All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun;

(ii) Coarse aggregate shall be cooled by constant watering where possible;

(iii) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary;

(iv) Rapid-hardening cement shall not be used;

(v) Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Engineer.

When the air temperature is above 20°C loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the
mix (Clause 14.2). In order to maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix (Clause 14.2).

The maximum water/cement ratios indicated in Clause 14.2 may be increased with the Engineer’s permission by 0.05 (or 2.5 litres/50 kg of cement) during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.

As soon as possible after concreting, the formwork shall be stripped (Clause 14.4) and the surface of the concrete shall be treated in accordance with Clause 14.5.

Where drying winds are encountered, wind shields shall be positioned as directed by the Engineer to protect exposed surfaces of the curing concrete.

**Wet Weather Concreting**

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment, and the areas to be concreted are adequately covered.

During showery weather, the Contractor shall ensure that work can be concluded at short notice by the provision of stop ends. On no account shall work be terminated before each section, between one stop end and another, is complete. Adequate covering shall be provided to protect newly placed concrete from the rain.

**Holes, Cavities and Fixings**

The Contractor shall be responsible for the coordination of all requirements of his Sub-contractors as regards provision of holes, chases, cavities and fixings and shall, if required by the Engineer, prepare drawings giving details of his and his Sub-contractor’s requirements and shall send copies of such drawings to the Engineer prior to construction.

Holes, etc. shall be accurately marked and boxed-out for before concreting operations commence and, without the Engineer’s prior approval, no such holes, etc. shall be formed after the concrete has set.

Where bars, if placed to specified spacing would foul holes of size less than 250 mm x 250 mm the full length of the bar shall be moved to one side and in the case of holes exceeding 250 mm x 250 mm the bars shall be cut on site and lapped with additional equivalent bars, or as otherwise indicated on the drawings.

Wherever possible, the Contractor shall build in all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and between the top and bottom steel layers in slabs and similar members.

The proposed position of all conduits 25 mm and over in diameter which are to be enclosed in the concrete shall be shown accurately on a plan to be submitted to the Engineer, whose approval shall be obtained before any such conduit is placed.

Bolts, hooks and other fixings shall be embedded in concrete, or holes shall be drilled and fitted with threaded expanding anchors to receive the bolts. The Contractor shall ensure that bolts, hooks, etc.

**SPECIFICATIONS CONCRETE**

are accurately positioned. Holding down bolts for machinery shall be set to template.

Where brick or stonework is to form a facing to the concrete or where the end of a brick or stone wall butts against a concrete face, galvanised metal ties of approved manufacture to BS 1243 shall be incorporated. The distance between ties shall be gauged with due regard for the bonding of the walls, and at intervals required by the Engineer.

**Protection and Curing**

Newly placed concrete shall be protected by approved means from rain, drying winds, sun and contact with substances which can adversely affect it.

No traffic or constructional loads shall be permitted on newly placed concrete until it has hardened sufficiently to take such traffic or load, and only then with the approval of the Engineer.

Concrete shall at no time be subjected to loading (including its own mass) including compressive stress until it has reached 0.40 of its specified 28 day strength.

Any concrete surfaces, arisises and treads of stairways which might be damaged during the construction of the Works shall be adequately protected.

All structural concrete shall be cured using methods approved by the Engineer.

The method of curing shall prevent loss of moisture from the concrete. Immediately after compaction and for 7 days thereafter concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes and from drying out.

The curing time shall be the number of days given in Table 14.7 unless the average temperature of the concrete during the required number of days falls below 10°C in which case the period of curing shall be extended until the maturity of the concrete reaches the value given in the table.
### Table 14.7 Normal Curing Methods

**Minimum period of protection for different types of cement**

<table>
<thead>
<tr>
<th>Conditions under which concrete is maturing</th>
<th>Number of days (where the average temperatures of the concrete exceeds 10°C during the whole of the period)</th>
<th>Equivalent maturity (°C hours calculated as the age of the concrete in hours multiplied by the number of degrees Centigrade by which the average temperature of the concrete exceeds 10°C)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Type IV</td>
<td>Type I or Type V</td>
</tr>
<tr>
<td>1. Hot weather or drying winds</td>
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<td>4</td>
</tr>
<tr>
<td>2. Conditions not covered by 1.</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Type IV - Low Heat Portland Cement/Portland - Pozzolana Cement  
Type I - Ordinary Portland Cement  
Type V - Sulphate-resisting Portland Cement  
Type III - Rapid-hardening Portland Cement  
Hot weather - Temperature over 16°C
Curing shall be carried out using either of the following basic methods, or any other method agreed with the Engineer. Methods involving the use of dampened hessian coverings shall not be used. The method adopted for any particular situation shall be agreed with the Engineer.

**A. Membrane Applied by Spray**

Liquid membrane compounds shall be applied to moist concrete surfaces as follows:-

(i) **Unformed Surfaces**

The compound shall be applied immediately after the free water has left the surface.

(ii) **Formed Surfaces**

The compound shall be applied immediately after removing the forms. If there is appreciable drying, the surface shall be mist sprayed with water to produce a uniformly damp appearance before the compound is applied.

The compound shall be applied in one or two separate applications to produce complete and uniform coverage of the surface. If the compound is applied in two increments, the second application shall follow the first within 30 minutes. The method and rate of application shall be in accordance with the compound manufacturer’s instructions.

If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of compound shall be applied to the affected area equal in curing value to that originally applied.

Compound applied to construction joint surfaces, or to other surfaces to which concrete is to be bonded, shall be removed prior to placing the fresh concrete.

Depending on the surface to which it is to be applied the compound shall conform to the following requirements of AASHTO M148.

(i) Exposed and vertical concrete surfaces - Type I-D (clear compound with fugitive dye).

(ii) Unexposed top surfaces of foundations and superstructures - Type 2 (white pigmented).

**B. Polythene Sheetig**

The concrete surfaces shall be covered with white polythene sheeting as follows:-

(i) **Unformed Surfaces**

The sheeting shall be laid over the surface as soon as possible without marring the surface, and not until initial stiffening has taken place if a brushed or tamped finish is required.

(ii) **Formed Surfaces**

The surfaces shall be covered immediately after the removal of the forms.

The sheeting may be in contact with the concrete or made into portable shelters on light weight frames. In both cases, the sheeting shall be jointed and sealed against the concrete surfaces to prevent wind blowing between the sheeting and the concrete.

The white polythene sheet shall conform with the requirements of AASHTO M171. On no account shall clear or any other colour of sheeting be used.

**C. Other Curing Methods**

These shall be agreed with the Engineer. Methods involving the use of dampened hessian coverings shall not be used, unless at least 2 layers of continuous hessian are used and they are kept continuously wet and protected from winds which cause accelerated drying.

Where the thickness of concrete placed exceeds 1.5 m, the Contractor shall submit for the Engineer’s approval proposals to ensure that, during the curing period:-

(a) the rate of rise of temperature in the concrete does not exceed 15°C per hour for the first 3 hours;

(b) thereafter the rate of rise and fall of temperature in the concrete does not exceed 35°C per hour;

(c) the maximum temperature in the concrete does not exceed 70°C; and

(d) the maximum difference in temperature between the core and the surface of the concrete does not exceed 20°C.

The proposals shall include consideration of:-

(a) concrete mix design;

(b) temperature of mix at time of placing;

(c) method of curing.

Where required by the Engineer, the Contractor shall carry out temperature measurements in the concrete. The method and procedure of temperature measurement shall be agreed with the Engineer.

**Joints**

(i) **Construction Joints**

The position of construction joints, when not shown on the Drawings or otherwise required by this Specification, shall be decided on site having regard to the Plant and labour made available by the Contractor for the manufacture, placing and compaction of the concrete as well as its curing, the climatic conditions prevailing at the time of concreting, the nature and size of the formwork, and the conditions of operation of the work. Waterstop shall be provided to all construction joints on water retaining or excluding structures. The Contractor shall submit his proposals to the Engineer for his approval at least fourteen days before commencing the work.

Construction joint surfaces shall be treated by the “wash-off” method explained below, except where it cannot be practically effected, in which case they shall be treated in accordance with Clause 14.5 as for the placing of new concrete against hardened concrete.

When expanded metal lathing is used for the formation of construction joints a rebate will not be required to be formed. The expanded metal lathing shall be left in the work and shall not extend closer to the finished surface of the concrete than 25 mm. It shall be securely fixed to the reinforcement.

The following particular requirements shall also be observed:-

* Slabs supported on the ground

In order to ensure control in the placing of concrete the Contractor shall provide control boards to form panels not larger than 15 m² in area. These shall be lifted as the concreting proceeds except where they are of expanded metal in which case they may be left in position as part of the permanent works, provided that they shall not extend closer to the finished surface of the concrete than 25 mm. In the event of a breakdown in the supply of concrete the Contractor shall ensure that an alternative supply of concrete is made available (to finish the work against the control boards acting as stop ends). The joint so formed shall then be treated as a construction joint. Where Ready-mixed concrete is permitted (Clause 14.7) the control boards shall be positioned so as to enclose a volume of concrete equal to that delivered by each truck.

Construction joints and control joints shall be formed normal to the surface of the retained concrete.

* Suspended Beams and Slabs

T-beams shall be formed to their full depth integrally with the adjacent slab and without horizontal joints.

* Columns

Where kickers are indicated on the drawings these shall be cast together with the slab or beam below. On no account shall kickers be cast as a separate operation. Alternatively, the Contractor may adopt “kickerless construction” methods providing he can satisfy the Engineer that his system is reliable and does not compromise workmanship.

* Walls

Horizontal construction joints in walls shall be formed along straight lines coinciding with the full height of the formwork. The height of the formwork thus controlling the height of the pour shall be determined with reference to the availability of concrete, the size and amount of reinforcement and the means of compaction available.
Unless otherwise indicated on the drawings or otherwise permitted by the Engineer for the construction of circular tanks, concreting shall be carried out continuously for the full circumference without vertical joints. Where permission is granted for the use of vertical joints the Engineer may order, at no extra cost to the Employer, the inclusion of an approved type of water stop.

In the case of rectangular tanks, vertical joints shall not be positioned closer to any corner than one metre. They shall be formed with properly rebated stop ends or, where conditions permit, by the use of expanded metal lathing. Unreinforced manholes shall be constructed without vertical joints.

(ii) The "Wash-off Method" of preparing Construction Joints

As soon as possible after concreting, and while the surface is still green, the surface of the concrete forming the joint shall be freed of loose aggregate and sprayed with a fine spray of water to prevent the formation of laitance. Subsequently all excess water shall be removed by a jet of compressed air and the surface left clean to receive further concrete.

Where expanded metal lathing is used for construction joints, this method of surface preparation shall be used in every case.

(iii) Movement Joints

These shall include contraction and expansion joints and shall be as indicated on the drawings. Contraction joints will be either full contraction joints or partial contraction joints. Where partial contraction joints are specified a period of at least five days shall elapse between the concreting of the section on each side of the joint.

Where the drawings indicate a contraction gap to be formed in any panel (this gap will not exceed one metre), concreting on either side of the gap shall be carried out so as to form partial contraction joints at each side of the gap. Prior to the concreting of the gap section, the joint surfaces shall be cleaned but otherwise left untreated. The concreting of the gap section shall not be carried out until a period of at least five days has elapsed after completion of the adjacent sections.

Alternate panel construction (other than contraction gap construction outlined above) will be permitted only with the approval of the Engineer, or in those cases where either the reinforcement is not continuous through the joint or where the panels are separated by expansion or contraction joints.

Unless otherwise specified or permitted by the Engineer all waterstop shall consist of rubber or PVC. Jointing of waterstop shall be by vulcanising, except where PVC is specified or permitted in which case joints shall be by fusing or welding. Materials shall be obtained from an approved manufacturer whose recommendations as to jointing shall be fully complied with.

(iv) Waterstop and Jointing Materials

Waterstop and jointing materials shall be obtained from an approved manufacturer.

All waterstop and jointing materials which are not required for immediate use shall be stored at all times in a cool damp place.

Waterstop shall be manufactured of rubber or PVC (polychloroprene) as shown on the drawings, and shall be of the type and size shown on the drawings. Site joints shall be made strictly in accordance with the manufacturer’s instructions and all intersections and junctions shall be obtained prefabricated from the approved manufacturer.

Joint filler shall be manufactured of natural bonded cork or other approved material which remains serviceable when wet. Joint filler shall be cut and trimmed accurately to suit the joint profile and shall be maintained accurately in position by means of an approved adhesive. The compressibility of the filler shall be such that it can be compressed to 50% thickness with a pressure of not less than 0.07 N/mm² and no greater than 0.4 N/mm² square. After 50% compression, the material should recover to at least 70% original thickness within 30 minutes. On no account shall fibreboard or similar be used as filler.

Joint sealing compounds shall be approved polysulphide based compounds suitable for sealing joints in horizontal and vertical/sloping concrete surfaces as appropriate. Sealing compounds shall be applied strictly in accordance with the manufacturer’s instructions and shall completely fill the joint recess. Surface primers shall be from the same manufacturer as the sealants themselves. Joint sealing compounds shall be entirely suitable for contact with potable water where these are used in water retaining structures.

Waterstop shall be located and maintained accurately in position and details of the proposed method of fixing shall be submitted to the Engineer for approval. On no account shall waterstop be secured by nails or by any other means involving puncture of or damage to the waterstop material unless purpose made nailing flanges are incorporated in the design of the waterstop.

(v) Slip Membrane

The slip membrane shall be "slipstrip" as supplied by Serviced Limited, Ajax Avenue, Slough, Berkshire, UK or similar approved material. The slip membrane shall be not less than 1.5 mm thick and shall be a plastic preformed strip with low coefficient of friction specifically manufactured for use as a separating membrane in sliding joints between concrete surfaces. Each sliding joint shall comprise two layers of the membrane unless otherwise shown on the drawings.

The concrete surface to which the slip membrane is to be fixed shall be finished with a steel float to provide a smooth true surface free from dust and loose particles.

(vi) Expandafoam

Expandafoam shall be as supplied by Expandite Limited, 1-9 Chase Road, London, NW10 6PS, UK or similar approved material. Expandafoam is a closed cell flexible polyethylene joint filler used where a readily compressible low load transfer joint filler is required. Expandafoam shall be fixed in position using a suitable adhesive.

Finishes - General

All exposed faces of concrete unless otherwise specified shall be hard, smooth and free from honeycombing, air and water holes and other blemishes.

All projecting imperfections shall be rubbed down with carborundum stone or by other approved means and grit and dust therefrom shall be thoroughly washed off with clean water.

Surface Finishes

(a) Wood float finishes shall be formed by smooth floating the accurately levelled and screeded surface. Care shall be taken to ensure that the concrete is worked no more than is necessary to produce a uniform surface free from screed marks.

(b) Steel trowel finishes shall be formed while the concrete is still wet by means of a steel trowel applied to an accurately levelled and screeded surface (see also Clause 14.7).

(c) Granolithic finishes shall conform to the recommendations laid down in "Specification for Granolithic floor toppings laid in-situ concrete", as published by the UK Cement and Concrete Association with special reference to monolithic construction.

(d) Screeded finishes shall be formed by levelling and screeding the concrete to produce a uniform, plain or ridged surface as specified; surface hardners shall be applied strictly in accordance with the manufacturers recommendations.

(e) Bush-hammered or pattern-worked finishes. When exposed aggregate is to be the surface texture, the Contractor shall ensure that a uniform distribution of the coarse aggregate takes place at the face. The formwork shall be removed as soon as possible from the face to be treated; the surface shall be thoroughly wetted and wire brushed, and bush-hammered or pattern-worked as and when instructed. Surface retarders shall be used only when permitted by the Engineer.

Bush-hammering or pattern-working shall not be relied upon to obscure any defects in the concrete face which arise from formwork imperfections.

(f) Power floated surfaces shall be worked to leave a "sand paper" finish and not a "glass" smooth finish. No floating of the surface shall be done when bleed water is evident. Under no circumstances shall near
cement be sprinkled or broadcast on the surface as a drier.

Making Good

On no account shall any faulty honeycombed or otherwise defective concrete be repaired or patched until the Engineer has made an inspection and issued instructions for the repair.

Honeycombed or damaged surfaces of concrete, which in the opinion of the Engineer, are not such as to warrant the cutting out and replacement of the concrete, shall be made good as soon as possible after removal of the formwork as follows:-

1:1.5 Portland Cement and sand mixture shall be worked into the pores over the whole surface with a fine carborundum float in such a manner that no more material is left on the concrete face than is necessary to fill the pores completely so that a uniformly smooth and dense surface of uniform colour is finally presented.

Removal and Replacement of Unsatisfactory Concrete

The Contractor shall on the Engineer's instructions to do so cut out and replace any concrete in any part of the structure if in the Engineer's opinion:-

(a) the concrete does not conform to the Specification, or
(b) deleterious materials or materials which are likely to produce harmful effects have been included in the concrete, or
(c) the honeycombed or damaged surfaces are too extensive, or
(d) the finished concrete sizes are not in accordance with the drawings within permissible tolerances, or
(e) the setting-out is incorrect, or
(f) the steel cover has not been maintained, or
(g) the protection, including curing, of the concrete during the construction was inadequate, resulting in damage, or
(h) the work of making good or other remedial measures the Engineer may indicate are not carried out to his satisfaction, or
(i) undue deformation of or damage to the works has taken place due to inadequate formwork, or to premature traffic or to excessive loading, or
(j) any combination of the above points has taken place resulting in unsatisfactory work.

14.6 TESTING

Sampling and Testing (see also Clauses 14.1 and 14.2)

The Contractor shall provide on the Site equipment, staff and labour for carrying out the sampling and testing outlined in columns 3 and 4 of Table 14.8, and he shall carry out any or all of these tests at such times and with such frequency as may be requested by the Engineer.

All equipment shall be calibrated and checked from time to time by an approved agency, as the Engineer may require.

The Contractor shall provide all samples required by the Engineer. Those samples to be tested in an off site laboratory shall be carefully forwarded by the Contractor to an approved laboratory. Results of laboratory and site tests shall be kept on site and copies of all test reports shall be forwarded in duplicate to the Engineer.

Each cube shall be marked with a distinguishing number (numbers to run consecutively) and the date, and a record shall be kept on Site giving the following particulars :-

(a) Cube No.
(b) Date and time made
(c) Temperature and weather conditions
(d) Location in work
(e) 7-day Test Date :
(f) 28-day Test Date :
Strength
Strength

Cubes shall be forwarded, carriage paid, to an approved Testing laboratory in time to be tested two at 7 days and two at 28 days. No cube shall be dispatched within 3 days of casting.

Authentic copies of all Work Test results shall be forwarded to the Engineer directly from the testing laboratory and one shall be retained on the site. The test certificates shall indicate all properties as required by BS 1881.

The Contractor must allow in his rates for concrete test cubes for all expenses in connection with the preparation and conveyance to the Testing Laboratory and testing of test cubes and no claim in respect of his failure to do so will be entertained.

Any batch of concrete which fails to achieve the required characteristic strength shall be removed and made good in accordance with this Specification. The Contractor shall carry out all such work at his own cost.

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Frequency of tests and the number of samples required will be governed by the results of the previous tests, the quality of the materials revealed during the tests, and the uniformity of that quality (see Clause 14.2). Should it become evident that the quality of concrete is deteriorating the Engineer may require additional samples to be taken and test cubes to be made and tested to determine the cause.

Loading Tests

The Engineer may direct that a loading test be made on the works or any part thereof if he deems such test to be necessary for one or more of the following reasons:-

(a) failure of "Site Cubes" to attain the strength requirements of Clause 14.2;
(b) premature removal of formwork;
(c) overloading of structure during construction;
(d) improper compaction and/or curing of concrete;
(e) any other circumstances attributable to alleged negligence on the part of the Contractor, which, in the opinion of the Engineer, may result in a structure being of less than the required strength;

If the loading test be ordered to be made solely or in part for reasons (a) to (d) the test shall be made at the Contractor's own cost.

If the loading test be ordered to be made for reason (e), the Contractor shall be reimbursed for the cost of the test if the result is satisfactory. No extensions to the Contract Duration shall be granted for delays and disruption resulting from these tests.

Loading test shall be carried out in accordance with the requirements of BS 8110.

If the results of the test are not satisfactory, the Engineer will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification, or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.
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The Engineer may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Engineer’s approval. The specimens shall be dealt with in accordance with BS 1881. Prior to testing, the specimens shall be available for examination by the Engineer. If the cores are ordered to be taken solely or in part for reasons (a) and (d) above, the work involved and the testing shall be made at the Contractor’s own cost. If the cores are to be taken for reasons (b), (c) and (e) above, the Contractor will be reimbursed the cost if the loading test described in the previous paragraphs proves satisfactory.

14.3 SPECIAL CONCRETE

No-fines Concrete

No-fines concrete for use in subsoil drainage shall consist of a 1:8 cement/aggregate mix by volume. Aggregate shall be 20 mm to 10 mm graded with no more than 5% passing the 10 mm sieve. Only sufficient water shall be added to ensure complete coating of the aggregate. One half of this water shall be placed into the mixer first, after which the aggregate and cement shall be admitted. After partial mixing the balance of the water shall be added until a consistency of mix is achieved.

Preliminary tests shall be carried out on the site to prove the suitability of the finished concrete, and adjustments made to the proportions and or grading as may be required by the Engineer.

Air-Entrained Concrete

Concrete for roads, and those structures where specified, shall include an approved air-entraining agent capable of producing a 5% air-entrainment with a tolerance of 0.5% (Clause 14.2).

The mix shall be purposely designed, having regard for the nature of grading of the aggregates and air-entraining agent being used.

Preference shall be given to the use of air-entraining agents which can be administered in fixed calibrated amounts through a dependable mechanical dispenser or sachet, and which are added to the mixing water.

Frequent air meter tests shall be carried out and the consistency of the air-entrainment maintained to the above tolerances by adjustments in the mix, as may be necessary.

Concrete in Benching

Concreting for benching in manholes, pumping stations and works structures shall consist of Grade C25P concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required and, while still green, shall be finished with not less than 50 mm of Grade C25P concrete to a steel trowelled finish and to the contours indicated on the drawings.

Ready Mixed Concrete

Unless otherwise stated the relevant clauses of BS 5328 shall apply.

Ready mixed concrete shall only be used with the prior approval of the Engineer. The Contractor shall not be relieved of his obligation to provide concrete to the standard laid down in this Specification by virtue of any approval given for the use of concrete supplied by others, and the Engineer reserves the right to withdraw his approval at any time consequent on any deterioration in the quality of the Concrete, or unsatisfactory delivery or any other reason he considers detrimental to the Works.

Ready mixed concrete manufactured off the site shall be transported in a revolving drum and shall be continuously agitated until it is used in the work unless otherwise approved. The time interval between adding water to the drum and placing shall not exceed 90 minutes. The time interval between completion of mixing and placing shall comply with Clause 14.5.

Granolithic Concrete

Refer to Clause 14.5.

Pneumatically Applied Mortar (Gunite)

(i) Requirements

The pneumatic application of mortar shall be carried out only by Contractors experienced in this type of work and who are in possession of proper Plant and equipment. Nozzlemen employed on the works shall be skilled operators.

The finished product shall be dense, of even texture and colour, and to the requirements of strength, tolerance and finish set out in this Specification.

(ii) Strength

After curing, the mortar shall be capable of producing cored samples with a 28-day characteristic strength of not less than 27.5N/mm².

(iii) Materials

Sand, cement and water shall comply with the requirements of Clause 14.2 of this Specification except that the sand shall conform to the grading of Zone 2 of BS 882.

(iv) Proportions

The proportions to be used in the mix shall be determined with reference to the requirements outlined in sub-clause 14.7(i) and the mix shall be not weaker than one part of cement to four parts of sand by volume, having regard to the adjustments for bulking of the sand.

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(v) Operation

Air and water pressures shall be such as to permit the proper application of the mortar, and shall be determined with reference to hose lengths and nozzle diameter.

Mortar rebound, recovered, cleaned and uncontaminated with extraneous matter, may be re-used but not for water-retaining structures. It shall be regarded as an equivalent volume of sand which shall not exceed 20 per cent of the total sand requirement. Rebound which has lodged in the formwork or between reinforcement shall be removed by compressed air.

Reinforcement shall be completely embedded in the mortar by the proper direction of the nozzle and the mortar shall be applied as a steady and uninterrupted flow from the nozzle.

Mortar application shall be discontinued at any section of the work where sagging of the mortar is in evidence.

(vi) Joints

These shall be formed by sloping the surface to a thin edge. Before applying new mortar, the surface shall be thoroughly wetted. Laitance shall be removed by the initial discharge of fresh mortar.

(vii) Tolerances

The thickness of applied mortar shall be not less than the dimensions shown on the Drawings nor greater than 10 mm over those dimensions, unless otherwise indicated on the Drawings or otherwise permitted.

(viii) Protection and Curing

Shall be carried out in accordance with the requirements of Clause 14.5.

(ix) Finishes

Unless otherwise specified all surfaces shall be brought to a granular textured finish by means of a wooden float.

(x) Cold Weather Work

No application of mortar shall be made against frozen surfaces nor when the air temperature is below 5°C.

(xi) Making Good

Any defective work shall be cut out immediately and made good with fresh mortar pneumatically applied.
Cement Grouts

Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.

Pumped Concrete

Where pumping of concrete is permitted to be used no relaxation of the requirements of this Specification will be permitted. Particular attention shall be paid to the proper grading of aggregates to prevent bleeding and/or segregation during the pumping operations. The inclusion of water-reducing additives or other materials, including flyash, to improve the flow characteristics of the concrete will only be permitted where it can be shown that they do not adversely affect the concrete either in the plastic phase or in the finished work.

14.4 PRECAST CONCRETE UNITS

Requirements

Unless otherwise agreed in writing by the Engineer, all precast concrete units shall be manufactured on site and shall be true to dimension and shape, with true arises and with perfectly smooth exposed faces free from surface blemishes, air holes, crazing and other defects, whether developed before or after building-in. They shall comply with the appropriate BS. (Note: Coping blocks and similarly exposed units are particularly susceptible to crazing when the concrete is manufactured using high water/cement ratios)

The maximum size of coarse aggregate in precast concrete shall not exceed 20 mm except for thicknesses less than 75 mm where it shall not exceed 10 mm.

The compacting of precast concrete shall conform with requirements given elsewhere in this Specification except for thin slabs where use of immersion type vibrators is not practicable. The concrete in these slabs may be consolidated on a vibrating table or by any other methods approved by the Engineer.

Steam curing of precast concrete will be permitted. The procedure for steam curing shall be subject to the approval of the Engineer.

The precast work shall be made under cover and shall remain under the same for seven days. During this period and for a further seven days the concrete shall be shielded by sacking or other approved materials kept constantly wet. It shall then be stacked in the open for at least a further seven days to season before being set in position. Where steam curing is used these times may be reduced subject to the approval of the Engineer.

Precast concrete units shall be constructed in individual forms. The method of handling the precast concrete units after casting, during curing and during transport and erection shall be subject to the approval of the Engineer, providing that such approval shall not relieve the Contractor of responsibility for damage to precast concrete units resulting from careless handling.

Repair of damage to the precast concrete units, except for minor abrasions of the edges which will not impair the installation and/or appearance of the units, will not be permitted and the damaged units shall be replaced by the Contractor at his own expense.

Except where precast work is described as "fair face" or as having "exposed aggregate" or terrazzo finish the moulds shall be made of suitable strong sawn timber true in form to the shapes required. Unless otherwise described, faces are to be left rough from the sawn moulds.

Where precast work is described as "fair face" the moulds are to be made of metal or are to have metal or plywood linings or are to be other approved moulds which will produce a smooth dense fair face to the finished concrete suitable to receive a painted finish direct and free from all shutter marks, holes, pittings, etc. Where precast work is to have an "exposed aggregate" or terrazzo finish the moulds shall be constructed to the requirements given for moulds for "finished fair" work.

The method of achieving the exposed aggregate finish shall be "aggregate transfer" or other approved method.

Kerbs


Approved air-entraining agents may be permitted to be used providing that approved adjustments are made to the mix with regard to water and fine aggregate proportions (Clause 14.2). In such cases the moisture absorption limits set out in BS 340 may be neglected subject to the concrete satisfying the freeze thaw test laid down under the heading "Weir Blocks and Sills".

Paving Slabs

Paving slabs shall conform to BS 368 and shall be 50 mm thick unless otherwise specified.

Other Blocks

Blocks used for building work and filter bed walls shall conform to BS 6073: Part 1: 1981.

Wall Units

L-shaped wall units shall conform to the requirements of BS 8110. Where it is not intended to use coping blocks for the protection of the upper exposed surface of the units, the uppermost 150 mm, for the full width of the unit, shall be formed with concrete composed of aggregate complying with BS 882: 1992. Such concrete shall be formed integrally with the main body of the concrete.

Other Items

Manhole ring units, tapers, cover slabs, segments and concrete pipes are referred to under their particular heading.

14.5 SITE BOOKS AND STANDARDS

Instructions to be Recorded

The Contractor shall provide and keep permanently on the Site a numbered triplicate book wherein the Contractor shall record all instructions relating to concrete work issued by the Engineer. One copy of every entry therein shall be sent to the Engineer on the same day as the entry is made.

Site Diary

The Contractor shall provide and keep permanently on the Site a continuous entry diary wherein the Contractor shall record details of formwork, construction, placing of
reinforcement, concreting and curing operations, striking of formwork, making good and daily temperature and weather conditions. This diary shall always be available for inspection by the Engineer.

Copies of Standards and Codes

The Contractor shall provide and keep permanently on the Site copies of the following British Standard Codes of Practice:

- BS 812
- BS 882
- BS 1881
- BS 4466
- BS 5328
- BS 5628
- BS 8007
- BS 8110
- KS 1725
- SABS 1085

The Contractor shall in addition provide and keep permanently on the Site copies of such other Standards, Codes, Notes and Specifications as may be required by the Engineer.

14.6 WATER RETAINING STRUCTURES - SPECIAL CLAUSES

Note: In the event of any differences between the "Special Clauses" and the previous Concrete Specification the provisions of these "Special Clauses" shall have precedence.

Making Good

The cement mortar used in filling recesses in the concrete formed by bobbins in connection with formwork shall contain an approved expanding admixture.

Construction Joints in Water Retaining Structures

In water retaining structures PVC waterstops not less than 130 mm wide manufactured by an approved manufacturer shall be built into all construction joints in external walls and construction joints in roofs of potable water retaining structures. Construction joints shall be formed at positions agreed by the Engineer.

The cost of forming construction joints shall be included by the Contractor in his general concrete rates.

Watertightness of Structures

The Contractor shall be solely responsible for the watertightness of structures and any remedial measures necessary.

Hydrophilic Rubber Sealer

Hydrophilic rubber sealer shall be co-extruded from chloroprene and hydrophilic rubbers into a cellular strip approximately 25 mm x 7 mm thick which expands as it absorbs water. The strip shall incorporate an expansion delay coating to prevent activation during setting of the surrounding concrete.

Hydrophilic rubber sealer shall be applied to the perimeter of all pipes to be built into concrete structures, to existing concrete walls and slabs at or below water levels which have been demolished and require extension, and to other locations as indicated on the Drawings.

The strip sealer shall be bonded to the pipe diameter or on to the face of demolished structures on to which new concrete is to be placed so as to be at least 100 mm from the wall surface. Where dowel bars are incorporated in bonding new concrete to old the sealer shall be placed above the dowel bars on the "wet" side of the structure. Bonding shall be accomplished using proprietary neoprene or epoxy adhesives to ensure the sealer is not disturbed during placement of the concrete.

The sealing strip shall be from an approved supplier and application shall be strictly in accordance with the manufacturer's recommendations.

Waterproof Membranes for Concrete Roofs and Gutters

Concrete roofs and gutters shall be waterproofed by the provision of a membrane to be laid on top of the slab. The membrane shall be a cold applied preformed waterproof laminated layer comprising a HDPE carrier film or similar approved with a solar reflective surface and a self adhesive rubber bitumen compound complying with the requirements of BS 8102. The membrane shall exhibit a tear resistance of at least 250 N/mm when tested in accordance with ASTM D1004. Adhesion to primed concrete to itself shall exceed 1.75 N/mm when tested in accordance with ASTM D100, and a puncture resistance of 290 N 65 mm when tested in accordance with ASTM E154. Membranes shall exhibit a water resistance of not more than 0.14% after 24 hours when tested in accordance with ASTM D574. The contractor shall submit proposals for waterproof membranes for approval, together with manufacturers catalogues and technical literature.

Waterproof membranes shall be installed entirely in accordance with the manufacturer's instructions. Membranes shall be continued up the internal face of the parapet wall and finished centrally under the coping. Adjacent strips of membrane shall be overlapped to provide a waterproof joint. The provision of a waterproof membrane on the roof slab shall not relieve the Contractor of his responsibilities to produce a waterproof roof slab which shall have successfully passed a watertightness test before the membrane is installed.
PART 15 FENCING

15.1 Generally
The level of the top of fencing is to be as directed by the Architect but is generally to follow the mean level of the ground on the line of the fencing. Any minor excavations on the line of the fencing to enable this to be achieved to be allowed for in the rates.

15.2 Standards
Fencing is to comply with the requirements of B.S. 1722 and B.S. 4102 in all respects.

15.3 Chainlink and timber post fencing
Fence posts to be 100 mm diameter cedar posts soaked in an anti-termite solution for a period of one week.

Fence posts are to be spaced at 3.0 metre intervals and 2600 mm long overall. The post to be six times holed for wires.

Raking struts to be 3000 mm long with one end splayed to suit notch in main post.

Main posts, spaced at 9.0 metre centres, and corner posts to be 2600 mm long overall. The posts to be six times holed for wires or fixing bolts and twice notched as required to receive ends of raking struts.

Concrete filling around post bases to be one end splayed to suit notch in main post.

Intermediate and main post bases to be excavated to allow posts to be let into the ground for a vertical depth of 600 mm and filled with 600 mm x 600 mm x 400 mm deep concrete well packed around post, the excavated material to be part returned, filled and rammed and the surplus removed.

Raking strut bases to be as last but let into the ground for a vertical depth of 600 mm and filled with 450 mm x 450 mm x 300 mm deep concrete.

Line wires to be No. 8 S.W.G. galvanized mild steel fixed complete with all galvanized eye bolt strainers, winding brackets and other necessary fittings.

Tying wire for securing chain link fencing to line wires to be No. 16 S.W.G. galvanized annealed mild steel wire.

Chain link fencing to be manufactured from No. 16 S.W.G. galvanized annealed mild steel wire woven into 500 mm mesh.

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mild steel wire woven into 500 mm mesh with barbed top and 2.0 metres high. The fencing is to be supported by three single and one double (at top) lines of line wire and fastened to each line at 1 metre horizontal intervals with tying wire.

15.4 Removing Existing Fencing and Gates
Where instructed by the Engineer the Contractor shall carefully remove existing fences and gates, dismantle the components and stack them in separate heaps where directed. All wires shall be neatly coiled and tied. Materials which in the opinion of the Engineer, are not suitable for re-use shall be destroyed or removed to a tip to be provided by the Contractor.

15.5 Stockproof Fencing
Where stock proof fencing is called for in the Bills of Quantities or ordered by the Engineer the contractor shall provide 75mm sawn cedar posts painted with two coats of creosote, firmly fixed into the ground and placed at 2.1m centres together with 100mm diameter posts suitably strutted at all changes of direction, and having four six-gauge wires equally spaced throughout its height of 2.1m. The Contractor’s rate for stockproof fencing shall include for its provision, erection, maintenance during the period of the Contract. The fence shall remain the property of the Employer.

15.6 Temporary Fencing
Where temporary fencing is called for in the Bills of Quantities or ordered by the Engineer it shall comprise 75mm diameter sawn cedar posts firmly fixed into the ground and placed at 2.0m centres together with 1.0mm diameter posts suitably strutted at all changes of direction, and having four wires equally spaced throughout its height. The Contractor’s rate for temporary fencing shall include for its provision, erection, maintenance during the period of the Works, and removal on completion of the Contract. The fence shall remain the property of the Contractor.

15.7 Protective Fencing of Trees
Where ordered the Contractor shall supply and erect around specified single trees or groups of trees to protect them from damage, split bamboo fencing of approved construction, 2.2m high above ground rough posts, firmly fixed in the ground. The posts shall be at 2.0m centres or where required for change of direction. The Contractor shall include in his rate for the satisfactory maintenance of this fencing for the period of the Contract.

15.8 Chainlink Fencing
The fencing will be erected round the perimeter of the site in the position shown on the drawings or as directed by the Engineer. The top of the fence shall have a uniform gradient along each side approximating to the main profile of the ground, any anulation in ground levels being trimmed off. Any minor excavation will be allowed for in the Contractor’s costs.

The concrete post for fencing shall be precast concrete post, 3280 mm long but with the last 600 mm curved at an angle of 45 Degrees to the vertical. All the corner posts shall be 140 mm square and the straining posts will be 130 mm square. The intermediate posts will all be 100 mm square. The posts shall be sunk 775 mm into the ground and embedded 450 mm round in a Class 15 concrete base. The posts shall be provided at 3000 mm intervals. The straining posts shall be erected not further apart on straight lengths; at every corner and opening and acute changes in direction or level.

Struts to straining posts shall be 3000 mm long and 100 mm square and set at an angle of 45 Degrees to the vertical. The foot of the strut shall be sunk into the ground to a depth of 775 mm and embedded in 450 mm diameter Class 15 concrete bed.

The chainlink shall be of standard mesh size 50 x 50 mm. It shall be made of annealed mild steel to BS 4102:1990. The mesh tolerance shall also be in accordance with BS 4102. The mesh will be hot-dip galvanised with minimum of 240 g/m² Zinc coating and 0.40 mm P.V.C. coating.

The P.V.C. exposed to rapid ageing according to the conditions mentioned below shall not show cracks, abrasion, swelling or appreciable colour changes.

1. 2000 hours ageing with ultraviolet rays in accordance with ASTM D 14499 - 64 (77) and ASTM G23-69 (75) apparatus Type E
2. 240 hours ageing at high temperatures, 105 Degs. C. in accordance with ASTM D 2287-798 and ASTM D 1203-67 (74).

The curved top 600 mm shall be strutted with barbed wire galvanised with a minimum Zinc coating of 75 g/m² and PVC coating as above. The barbs will be 100 mm long at a spacing of 100 mm. The wires will be spaced at 200 mm intervals.

15.9 Barbed Wire Fencing on Timber Posts

General:

Survey beacons are on no account to be disturbed in erecting fencng and then posts are to be set out in such a manner that beacons are avoided. Fence lines may if necessary and with the approval of the Consultant be fixed slightly off the pilot boundaries.

Posts:

Fencing posts are to be of gumpole as free from sapwood as possible, reasonably straight, well shaped, free from serious defects and soaked or treated with engine oil.

Barbed Wire:

Barbed wire fences is to be two-ply No 12½ S.W.G. galvanised steel wire with four point barbs at 75mm centres.

Barbed Wire Fences:

Barbed wire fences are to have posts not more than 3.0 metres apart and 2.0 metre high above the ground. The post at each end of fences, at each side of each opening and at each change in direction is to be a straining post 2.00 metre long, 150 mm diameter at the top notched to receive strut or struts 1500 mm long x 100mm diameter, each strut with a gumpole base plate 300 x 100 x 50 mm. Intermediate posts are to be 2.0 metre long x 120 mm diametre at the top.

At a height of 300, 600 and 900mm fix stands of barbed wire loosely fixed to intermediate posts with 25 mm galvanised staples, strained taut and securely stapled to the straining posts.
PART 16 PIPELINES, SEWERS AND DRAINS

16.1 Excavation for Pipelines, Sewers and Manholes

Excavations will be considered to be from ground level at the centre line of the pipe measured in the invert level of the pipe. The Contractor must allow in his prices for all extra excavation required to allow for thickness of pipes and concrete beds.

The ground shall be excavated to the lines and depths shown on the Drawings or to such other lines and depths as the Engineer may direct. Excavations taken out to a greater depth than is necessary shall be filled in to the required level with concrete of the appropriate Class as specified for the pipe bed at the Contractor's own cost. Trenches shall be of sufficient width to enable the pipes to be properly laid and jointed. Special care shall be taken to provide a solid and even bed for the barrels of the pipes and, where a concrete bed is not specified, the floor of the trench shall be properly shaped to receive the sockets.

16.2 Supports for Pits, Trenches and Other Excavations

The sides of pits, trenches and other excavations shall where necessary be adequately supported to the satisfaction of the Engineer by timber or by other approved means, and all such excavations shall be of sizes sufficient to enable the pipes and concrete to be laid accurately, and proper refilling and compacting to be carried out.

The Contractor shall take all precautions necessary for the safety of adjoining structures and buildings by shoring, opening in short lengths or otherwise, during the time the trenches are open.

Where directed by the Engineer, the supports shall be left in trenches or other excavations, and any such supports so left in will be measured and paid for as valued by the Engineer except where in the opinion of the Engineer the necessity for leaving the supports in has arisen from carelessness or neglect on the part of the Contractor. The prices inserted in the Bills of Quantities for excavation of trench shall include for excavation of trenches, shoring or timbering as necessary, backfilling after laying pipes and carting away surplus excavated material. The Contractor shall make good at his own expense any overbreak or damage resulting from slips, falls or caving in and all cavities thus resulting shall be filled with dry rubble or Class F concrete at the Engineer's discretion.

16.3 Rock Cutting in Trenches for Pipes

Where solid rock is met with in trenches, it shall be cut out to a depth of 100 mm below the intended level of the bottom of the pipes, and replaced with 100 mm of concrete of the appropriate Class. In measuring such rock excavation the Contractor will be allowed a width of 300 mm more than the external diameter of the pipes to a level of 100 mm below the bottom of the pipes. The price inserted in the Bills of Quantities shall be held to cover all expenses in connection with excavating the rock and disposing of surplus material as directed by the Engineer.

16.4 Water in Trenches for Pipelines and Sewers

Trenches shall be kept free from water until, in the opinion of the Engineer, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Engineer may deem necessary.

16.5 Putrescent Matter

The Contractor shall include in his excavation prices for the removal and disposal of all filth or putrescent matter met with in the execution of the Works to suitable places to be provided by the Contractor clear of the Works, and on no account shall it be so placed to allow its gaining admission into the pipes, laid or un laid. Such material shall be replaced as required by surplus excavated soil.

16.6 Sight Rails

Before trenches are excavated sight rails shall be provided and erected by the Contractor at convenient intervals not exceeding the distance between those manholes for which an invert level is given in the Drawings, or 50 metres whichever is the less. Rails shall be of substantial construction and shall be painted in alternate contrasting colours in such a manner as to indicate clearly the lines and levels, and, for use in conjunction with them, posts shall be firmly planted one on either side of the trench. The Contractor will be held responsible for any errors, which may occur in the execution of the Works through sight rails being disturbed, faulty setting out therefrom, or from any other cause whatsoever and shall make good at his own expense.

The sight rails shall be fixed with the upper edge an integral height in metres above the level of the invert of the pipe being laid.

16.7 Inspection of Trenches

Before any pipes are laid in a trench the trench shall be inspected and passed as satisfactory by the Engineer.

16.8 Cleaning of Pipes

Before being laid in the trench each pipe and fitting shall be inspected and any dirt or foreign matter inside the pipe or fitting shall be removed. Spigots and sockets shall also be examined for cleanliness to ensure proper joints.

16.9 Pipe laying

In any length of drain, laying shall always be carried out from the lower end of the length to the higher. In cases of spigot and socket pipes the socket shall always be at the upper end of the pipe. Pipes shall be laid true to line and grade as directed by the Engineer. In order to prevent stones or soil from entering the pipe a suitable cover or plug shall be provided which is to be used for covering the mouth of the last laid pipe at all times while pipelaying is not proceeding.

16.10 Lengths for Laying

Pipes shall not be laid in a section of trench unless the whole of the excavation of that section together with the excavation of the intermediate and terminal manholes shall have been completed, inspected and passed as ready for laying, unless otherwise instructed by the Engineer.

16.11 Laying and Jointing Precast Concrete Pipes

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Precast concrete pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

Flexible Joints

These joints will be made in accordance with the manufacturer's instructions and to the satisfaction of the Engineer. The joint and ring shall be kept clean and free from dirt, oil, grease, or petrol or other deleterious matter.

Internally the joints shall have a uniform gap not greater than 6mm nor less than 3mm. Where the gap is outside the permitted limits or varies around the perimeter of the joint, the Engineer shall instruct the Contractor to relay the pipe or to grout the joint internally at his discretion. Such remedial work shall be carried out at the Contractor’s expense. Except where ordered by the Engineer to meet the requirements of this Clause grout will not be used in rubber joints.

Where shown on the Drawings or directed by the Engineer, concrete pipes shall be bedded and compacted around with granular material as specified in Clause 16.15 or concrete as specified in Clause 16.29, all in accordance with the Drawings.

The price inserted in the Bills of Quantities shall include for providing, laying and jointing pipes.

16.12 Pipes Laid with Open Joints

O.G. porous concrete pipes shall be laid unjointed with a space of 12mm between the spigot and the inner end of the socket. All pipes shall be packed and surrounded as directed by the Engineer with approved broken stone, sand or gravel aggregate, to the grading as shown on the Drawings or stated in the Bills of Quantities. The prices inserted in the Bills of Quantities shall include the trench excavation, providing and laying pipes, supplying and placing graded packing material, refilling trench and disposing of surplus all as specified.

16.13 UPVC Sewer/Drain Pipes

UPVC sewer/drain pipes shall comply with the latest revision of KS 06-217 (Class 41), and shall have rubber ring joints. Alternatively, sewer pipes shall be to BS 5481 and drain pipes to BS 4660. The suppliers of the pipes shall be able to supply adequate fittings for use with their pipes, particularly saddles, Y-branches, and protection sleeves.

16.14 Steel Pipes and Fittings for Above Ground Crossing

Steel pipes shall be in accordance with the latest revision of BS 534. They shall be lined internally with bitumen or coal tar enamel of the thickness specified in BS 534. They shall be sprayed with red oxide primer externally and finished in reflective aluminium paint.

16.15 Drains to be left clean on completion

On completion, all drains, manholes, etc., shall be flushed from end to end with water and left clean and free from obstructions.

16.16 Refilling Trenches

Trenches shall be refilled with suitable excavated material but not before the work has been measured and approved by the Engineer. For pipes which are not surrounded with concrete, the first layer of filling material shall be freed from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care under and round them. All filling shall be deposited and compacted in layers, not exceeding 225 mm loose depth, to a dry density not less than that of the adjoining soil. The last 450 mm of filling must be returned in the order in which it has been removed. Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn timber. Back-filling of trenches in open spaces shall be left 75mm proud of the general ground level.

16.17 Back filling of Manholes

Back-filling round manhole walls will not be started earlier than 3 days after the building or making of the wall nor sooner than 14 days over the cover slabs of manhole after these are cast.

16.18 Sub-Soil and Land Drains

Sub-soil and land drains shall be laid in trenches excavated to the alignment, widths, and depths shown on the Drawings or to such other lines or dimensions as may be required by the Engineer. The drains shall be formed of approved pipes as specified, laid with open butt joints to regular falls in
straight lines, and with the trenches refilled as directed by the Engineer to surfaces or ground level with approved broken stone, sand or gravel aggregate to a grading as shown on the Drawings or stated in the Bill of Quantities.

16.19 Connections of Existing Sewers and Drains and NCC Water Mains

Where shown on the Drawings existing sewers water mains and drains shall be properly extended, connected and jointed to new sewers, water pipes, culverts, drains or channels after obtaining approval from NCC. All such connections shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for future use or reference. Where pipe connections are made to a sewer, culvert, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete or masonry work and be so placed as to discharge in the direction of flow of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special connecting pipes as shown on the Drawings shall be supplied and be truly laid and properly jointed. For water connection into NCC mains, the contractor shall confirm size of existing main and have all fittings ready at least 24 hours before commencement of works, all to the approval of NCC.

16.20 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

Benching shall consist of concrete of the appropriate Classes

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 channels, providing a gross channel depth not less than the channel diameter. The intersection of the channel sides and the benching shall be finished in a sharp curve not greater than 3.00 mm 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 to the appropriate lass and finishes 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 finishes flush with cement mortar (1:3).

Walls of manholes and access shafts shall be constructed of (i) insitu concrete of the appropriate Class (ii) building stone in accordance with the Drawings.

Walls where constructed of stone shall be rendered internally for the full height with a cement and sand mortar (1:3) of at least 12.00 mm thickness and finished with a completely smooth surface.

Concrete side walls shall be fair-faced. They shall be brought up vertically to receive a precast slab formed of concrete of the appropriate Class and reinforced all as shown on the Drawings. Cast-iron manhole covers and frames 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 side walls 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, iron steps shall be built in with alternate steps in line vertically and with such additional hand irons as the Engineer may direct. Step irons must be set into the walls when these are built and not subsequently. Step irons shall comply with the requirements of Clause 22.30

All manholes when completed shall be watertight and to the satisfaction of the Engineer. The prices inserted in the Bills of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

16.21 Precast Concrete Manholes and Inspection Chambers

Precast concrete manholes and inspection chambers shall be supplied and laid generally in accordance with Clause 22.28 and the Drawings.

16.22 Gully Connections

Connection from gullies to sewers and surface water drains or ditches shall consist of concrete pipes and fittings jointed with cement mortar (1:3). All pipes, bends and junctions shall be laid to the lines and levels shown in the Drawings or as directed by the Engineer.

16.23 Surface Boxes, Covers, etc

Surface boxes, manholes and other covers lying within the Site of the Works, shall be raised, lowered, altered or removed as directed by the Engineer.

16.24 Gullies

Gullies complete with gratings and with rodding eyes where necessary, shall be supplied and laid in accordance with the Drawings. Where directed by the Engineer precast concrete gullies shall be laid on and surrounded with 100 mm of concrete of the appropriate Class, the concrete surround to be brought up to the underside of the frame or flush with the top surface as the case may be. Masonry gullies shall be constructed from 225mm building stone and rendered internally. The rates included in the Bills of Quantities shall include for excavation, provision of all materials, construction, making junctions with connections to main drains, accurate setting of frames to line and level, refilling and disposal of surplus materials. Gullies shall be trapped where leading into foul sewers or into combined foul and surface water sewers. Otherwise, they shall be trapped or untrapped as specified.

16.25 Completion of Drainage Works

All sub-soil and surface drains shall be completed in advance of the
construction of the verge and carriageway.

16.26 Temporary Stoppers

Junction pipes which are laid but not immediately connected to gullies shall be fitted with temporary stoppers or seals, and the position of all such junctions shall be clearly defined by means of stakes or training wires properly marked and labelled.

16.27 Provision for Future Connection to Manholes

Inlet pipes of the required diameters shall be built into the walls of manholes and elsewhere for future use and shall be of the diameters shown on the Drawings. The external ends of all such connections shall be sealed off with temporary stoppers, or otherwise sealed off as approved by the Engineer. The pipes shall be laid and jointed as specified in Clause 16.11 and during the placing of the concrete they shall be adequately supported.

16.28 Granular Bedding to Pipes

Immediately following excavation of the trench, pipes shall be laid and jointed except when shown otherwise on the Drawings or pipe bedding material. Brick or other hard material shall not be placed under the pipes for temporary support.

After jointing of the pipes the bedding shall be brought up equally on both sides of the pipe, first to the level of the centre of the pipeline and then up to a height 225mm above the top of the pipe barrel. The bedding material shall be carefully compacted for the full width of the trench with hand tools.

Pipes shall be laid so that each one is in contact with the bed throughout the length of its barrel, bedding material being scooped away at each socket in the case of socketed pipes so that the socket does not bear on the bed.

16.29 The Surrounding or Haunching of Pipes with Concrete

Surrounding or haunching of pipes shall be carried out using concrete of the appropriate Class. Before concreting commences pipes will be supported on concrete cradle blocks of design approved by the Engineer. The blocks shall be set by string line and traveller so that when they are firmly bedded they are in correct line and level to receive the pipes. The blocks shall be bedded on 1:3 cement sand mortar. Any additional excavation for the blocks below trench formation shall be done by hand and the cost of the blocks, bedding and additional excavation will be held to have been included in the Contractor’s rates for trench excavation.

After pipes have been laid and jointed concrete shall be placed to one side of the pipe and punned and tamped until it forms an even bed below the pipe after which filling will proceed evenly on both sides of the pipe. Concrete shall not be thrown directly onto the pipes.

The concrete protection shall be placed in one operation and no horizontal construction joints will be allowed. Care must be exercised to maintain the line and level of the pipe during this operation and any disturbance must be immediately rectified. The upper surface of the concrete shall be struck off with a wooden screed or template and neatly finished off. The rates shall include for any formwork that the Contractor requires to use under this item.

16.30 Invert Block and Stone-pitched Drains

Precast concrete invert blocks and side slabs shall be formed of concrete of the appropriate Class to the dimensions shown on the Drawings. Each course of side slabs required in the Bills of Quantities shall be interpreted as one complete row of side slabs to one side of the channel concerned. Stone used for channels shall be 225mm x 100mm building stone. Drains should not normally be laid to a radius of curvature less than 5 times the actual width of the drain.

Invert block and stone-pitched drains shall be constructed in the positions and to the levels and dimensions shown on the Drawings and laid to true line and even fall. Where under-filling is required it shall be 75mm maximum thickness layers of compacted murrum. The earth sides to such channels shall be neatly finished to a slope of 1 to 1 or such other slope as the Engineer may direct.

Invert blocks and side slabs shall be laid on a 75mm minimum thickness of compacted murrum and be neatly jointed with cement mortar (1:3) as the work proceeds. The rates included in the Bills of Quantities shall include for excavation, murrum bedding, providing, laying and jointing invert blocks or stone, back-filling and disposal of surplus, all as specified, and all insitu connections in concrete of the appropriate Class.

16.31 Intercepting Ditches

Intercepting ditches shall be excavated to regular falls and unless otherwise directed by the Engineer, when completed shall be 300 mm wide at the bottom with the sides trimmed back at a slope of 2.5 to 2. Where possible intercepting ditches shall be constructed in advance of general earthworks in cuttings and embankments.

16.32 Inspection and Testing of Pipelines

After pipes have been laid they shall be inspected and checked by the Engineer for grade, direction, line and appearance of inner surface. Any pipes inaccurately laid to grade, direction or line or the interior of which shows open or eccentric joints, ragged edges or protruding material must be made good or relaid as may be ordered by the Engineer, so as to conform with the Specification. After inspection and before haunching, casting or backfilling, the pipes shall be tested by one of the methods described in Clauses 16.33 and 16.34 of this Specification, or as may be directed by the Engineer. All necessary equipment, materials and labour required for the complete and proper testing of the drains shall be provided by the Contractor in accordance with the Conditions of Contract.

16.33 Air Test

All branches and openings in the length of drain under test shall first be sealed with approved expanding plugs and appropriate lids in the case of access fittings. After sealing, an air pressure of 100mm of water as measured on a manometer tube shall be applied. The drop in pressure after pumping has ceased shall not exceed 25mm of water in five minutes. Should the rate of pressure drop exceed that specified, a smoke test shall be applied for the
purpose of locating the fault. Any failure of the drains to withstand these tests and any defect which may be found while they are under test must be made good to the satisfaction of the Engineer and at the contractor's expense, and the test repeated. Upon the successful conclusion of the test, the pipes shall be back-filled in accordance with Clause 16.16 of this Specification.

16.34 Water Test

All branches and openings in the lengths of drain under test shall first be sealed with approved expanding plugs and appropriate lids in the case of access fittings. The pipes shall be filled with water in such a manner as will give rise to no shock and prevent any accumulation of air in the sewer.

When all air has been expelled and the pipes are saturated, the pressure in the drains shall be raised by means of a force pump or standpipe so that the length under test is subjected to a hydrostatic pressure of at least 2.2 metres head of water for concrete pipes. For UPVC pipes, testing shall be done under hydrostatic pressure of at least 5 metres head of water. The drop in pressure after pumping has ceased shall not exceed 25mm head of water in ten minutes. Should the rate of pressure drop exceed that specified the Contractor shall thereupon, at his own expense, search for and rectify any weakness or defect in the pipes and fittings under test to the satisfaction of the Engineer. The pipes shall then be subjected to the specified water pressure again and re-tested and repaired until a satisfactory test is obtained. No pipeline or other work shall be covered up until they have been approved by the Engineer.

The Contractor shall allow for supplying all water required for such tests and shall make provision for its disposal after use.

16.35 Testing of Manholes

Manholes shall be tested by filling to the adjacent ground level with clean water. After allowing a 60 minute period for initial absorption, no measurable subsidence in the water level shall occur during the next 30 minutes. The Contractor shall correct any leaks in the manhole at his own expense.

The Contractor shall, at his own expense, provide the water and everything necessary for the carrying out of the manhole test.

16.36 Infiltration Test

In the event of a high water table, the Engineer may order an infiltration test to be made on any section of drain. The average rate of infiltration as measured in such manner as the Engineer may direct shall not exceed 2 litres per kilometre of drain per minute or as specified by the Engineer.
PART 17 ROADS - 1
CONSTRUCTION OF SUB-BASES, BASES AND VERGES

17.1 Drains to be completed

Before the construction of the carriageways, footways or verges is begun, all drains, sewers, cable ducts or other special formation work shall be completed.

17.2 Compaction of Non-plastic soil immediately below formation level in cuttings

Where shown on the Drawings or directed by the Engineer, non-plastic soils shall, for a depth of 150mm, be scarified, pulverized and recompacted in accordance with the requirements of Clauses 13.7 and 13.10 for non-plastic soils. Work shall be continued in such a manner as to produce a maximum density of 100 percent at the optimum moisture content, or such other percentage as may be approved by the Engineer as a result of compaction trials.

Soft areas which may develop during compaction shall be removed and replaced by approved material.

17.3 Murram to Carriageway on Rock

Where the formation is rock, after excavation has been completed and if directed by the Engineer, a murram cushion shall be laid to the proper cross-falls to receive the carriageway base. It is anticipated that the depth of such murram shall not exceed 50mm and the cost of this work shall be included for in the rates for excavation in rock.

17.4 Preparation of Formation

The formation of carriageways, footways and verges shall be well cleaned, freed from mud and slurry, and entirely in accordance with the Specification. Where directed by the Engineer, the surface of newly prepared areas of the formation of sub-base shall, before the completion of each day’s work, be surfaced dressed in accordance with Clause 18.11. Alternatively, where directed by the Engineer, the formation shall be covered by the sub-base or base within 48 hours after formation level is reached.

Once the formation has been prepared, constructional traffic shall not be allowed to run thereon without the permission of the Engineer, which permission if given shall not relieve the Contractor from total responsibility for any damage caused by such traffic.

17.5 Granular Sub-base

Granular sub-base shall be of the thickness shown on the Drawings or stated in the Bills of Quantities, conform to the other requirements of this Clause and be constructed using one of the permitted aggregates in the following manner:-

### Aggregates

These shall comprise approved crushed building stone, crushed concrete, well-graded natural sands, gravels, rock or mixtures thereof.

#### Grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>75mm</td>
<td>100</td>
</tr>
<tr>
<td>38mm</td>
<td>85 - 100</td>
</tr>
<tr>
<td>5mm</td>
<td>25 - 45</td>
</tr>
<tr>
<td>No. 25</td>
<td>8 - 22</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

Wet sieving shall be used to determine the percentage passing the No. 200 sieve. Subject to the approval of the Engineer the proportion of material passing the No. 200 sieve may be increased to 10 percent provided that all the material passing the No. 200 sieve is non-plastic when tested otherwise in accordance with British Standard 1377: Methods of Testing Soils for Civil Engineering Purposes.

The material shall be laid and compacted at a moisture content not exceeding 5 percent, unless otherwise directed by the Engineer.

#### General Requirements

The material shall be laid in one or more layers, each not exceeding 150mm compacted thickness, to produce the specified total depth of sub-base to the width and correct line and levels shown on the Drawings as stated in the Bills of Quantities.

The material for each layer shall be deposited either into the hopper of a paver or box spreader or sufficiently evenly on the existing surface for immediate spreading by a motor-grader. Spreading shall be effected by one or other of the above types of machine.

Compaction shall be by means of an 8 - 10 tonne roller or by a vibratory tandem roller having a weight exceeding 3 tonnes until a state or compaction is achieved such that not more than one field dry density achieved during compaction trials with 10 passes of such a roller or vibratory roller.

The levels of the surface of the course shall be within the limits specified in Clause 17.7 for sub-bases.

17.6 Murram Sub-base

The murram sub-base shall be in accordance with Clause 22.8 and shall be of the thickness shown on the Drawings or stated in the Bills of Quantities. It shall be laid one layer and spread by a motor-grader or other plant approved by the Engineer. Compaction shall be as earthworks in accordance with Clause 13.10.

17.7 Scarifying Existing Surface and Making Good

Where a new carriageway abuts on to or include an existing carriageway and the Engineer so directs, the surface of the latter shall be scarified, adjusted and reshaped to conform with existing and new carriageways or crossfalls. Materials from the existing road shall be used or disposed of as directed by the Engineer.

17.8 Lean Concrete Base

#### General

Construction of a lean concrete base, including all preliminary trials, shall be in accordance with the provisions of this Clause. Construction shall be to the specified thickness after compaction.

If the Contractor proposes to compact in one layer he shall satisfy the Engineer that with the plant and method of construction used the specified requirements can be achieved throughout the whole depth of the base. Failing such satisfaction the Contractor shall compact the base in two layers each of approximately equal thickness.

Where a base of more than 200mm of lean concrete is required and the specified compaction requirements cannot be met using single each not less than 100mm nor more than 200mm in depth after compacting the top layer laid immediately after compacting the lower layer so that in

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any vertical section the lean concrete shall be fully compacted throughout the whole depth and finished within two hours from the time of the completion of the mixing of the first batch of lean concrete in that section.

Aggregates

The aggregates shall consist of gravel, sand, crushed rock or a mixture of these materials. All aggregates shall comply with the requirements of British Standard 882 : Concrete Aggregates from Natural Sources. Gravel, sand or all-in gravel- sand mixtures shall be washed unless they can be shown to meet the requirements of British Standard 882 : Concrete Aggregates from Natural Sources, as regards freedom from clay, silt and other impurities.

Gradings and Maximum Size

The nominal size of aggregate shall be either 38mm or 20mm as stated in the Bills of Quantities. The aggregate may consist of coarse and fine aggregate batched separately or an all-in aggregate, but, subject to the following proviso, the gradings of the fine aggregate or the material passing the 5mm sieve in all all-in material shall be within Zone 2 or Zone 3 of British Standard 882 : Concrete Aggregates from Natural Sources, and the overall grading shall be within the limits shown in the table below.

In the event of the Contractor offering a material in which the grading of the aggregate or the material passing the 5mm sieve in an all-in material has a grading falling within either Zone 1 or Zone 4 of British Standard 882 : Concrete Aggregates from Natural Sources, the Engineer may approve its use and permit the proportions passing the 5mm sieve to exceed the figures given below by 5 percent for a Zone 1 material or to fall below the figures given below by 5 percent for a Zone 4 material subject to his being satisfied by trial mixes and a trial area laid with the plant to be used on the work, that a mix can be obtained which can be satisfactorily compacted.

BS Test Percentage by weight passing

<table>
<thead>
<tr>
<th>Sieve</th>
<th>38mm nominal 20mm nominal maximum size maximum size</th>
</tr>
</thead>
<tbody>
<tr>
<td>75mm</td>
<td>100</td>
</tr>
<tr>
<td>38mm</td>
<td>95 - 100</td>
</tr>
<tr>
<td>20mm</td>
<td>50 - 80</td>
</tr>
<tr>
<td>10mm</td>
<td>80 - 100</td>
</tr>
<tr>
<td>5mm</td>
<td>30 - 40</td>
</tr>
<tr>
<td>No. 25</td>
<td>35 - 45</td>
</tr>
<tr>
<td>No. 100</td>
<td>10 - 35</td>
</tr>
<tr>
<td>No. 6</td>
<td>0 - 6</td>
</tr>
</tbody>
</table>

Mix Proportions

The ration of cement to aggregate by weight (including any absorbed moisture but excluding free water in the aggregate), shall be not less than 1 : 20 and shall be such as to produce average crushing strengths to the requirements of this Clause. The ratio of cement to aggregate by weight shall not, however, be more than 1 : 15 except with the approval of the Engineer.

Water Content

The water content of the mixed concrete shall be such as to ensure that the degree of compaction specified below can be achieved under all normal working conditions.

Crushing Strength Requirements

The essential strength requirement for the material is that the average 28 - day strengths of groups of three cubes determined in accordance with the Section 3 of this Specification and shall be such that not more than one such average strength in any consecutive five such averages is less than 0.985 kg/sq. mm. If however the overall average of any consecutive five groups of three cubes (i.e. fifteen cube strengths) falls below 1.125 kg./sq. mm. at 28 days, the Engineer may require the use of different materials, mix proportions, plant or methods, notwithstanding any approval which may have been previously given to such materials, mix proportions, plant or methods.

Further, in order to ensure a high probability at an early stage that the above requirements will be met, the average 7-day strengths of groups of three cubes determined in accordance with Section 3 should not be less than 0.705 Kg./sq. mm and if more than one of the 7 day average strengths of groups of three cubes in any consecutive five such averages falls below 0.705 Kg/sq.mm the cement content shall be increased to such a value as may be approved by the Engineer and the making of cubes shall be continued at the same rate as at the start of the work until the results show that a satisfactory material is being produced.

Density of Compacted Base

The average density obtained from groups of three determinations carried out in accordance with Section 3 shall be not less than 95 percent of the theoretical density of material as compacted to zero air content calculated from the specific gravities, determined in accordance with British Standard 812 : Methods of Sampling and Testing of Mineral Aggregates, Sands and Fillers, and the nominal proportions of the constituents, including the water. If more than one average density in any consecutive five such averages fails to meet this requirement, the Engineer may require the removal of the base represented by the low densities and its replacement with further material to the requirements of this Clause.

Preliminary Site Trials

In the event of the grading of the fine aggregate or of the material passing the 5mm sieve in an all-in aggregate falling within either Zone 1 or Zone 4 of British Standard 882 : Concrete Aggregates from Natural Sources, the Contractor shall construct, at least ten days before the main work of base construction is started, an area of lean concrete base of 1,000 sq. metres as a preliminary trial at a site to be approved by the Engineer. For this trial the Contractor shall use the materials, mix proportions, mixing, laying and compacting plant and construction procedure that are proposed for the main work. The preliminary trial is to establish the suitability of the materials and mix proportions, and the efficiency of the mixing, spreading and compacting plant in handling and processing the proposed materials.

Testing of the materials, the crushing strength of the lean concrete and the density of the base shall be carried out during the trial in accordance with Section 14 of this Specification. The average 7-day crushing strength shall correspond to not more than 5 percent air voids.

Batching, Mixing and Transport of Mixed Material

Proportioning and mixing of the lean concrete shall be carried out in accordance with Section 14 except that, if batch mixers other than tilting or non-tilting drum mixers are used, the mixing time may be reduced to a value which shall in no circumstances be less than 45 seconds after all the materials including the water have entered the pan, trough or other mixing vessel, provided that the Engineer is satisfied as a result of
preliminary trials that adequate mixing is achieved with the reduced mixing time. Sufficient mixers shall be employed to ensure that a rate of not less than 20 metres per hour measured longitudinally of completed base can be maintained in order to permit satisfactory compaction of the material. Care shall be taken during tipping from the mixer, transit and spreading to prevent segregation. In particular when continuous mixers are used with a receiving hopper below, the mixed materials shall not be allowed to fall direct from mixer to transport vehicle with the bottom door of the receiving hopper open. The mixed material shall, where required by the Engineer, be covered during transit and while awaiting tipping to prevent wetting by rain or evaporation or moisture.

Spreading of Mixed Material

The lean concrete shall be spread by means of an approved box-hopper spreader or by bituminous pavers. If the latter are used and the width of the carriageway is greater than the width which can be laid by one pass of a single paver, the work shall be arranged using, if necessary, two or more pavers in echelon so that a free edge of spread material is not exposed for more than one hour.

Compaction

Compacting shall be carried out by means of a vibratory roller which applies a dead load of not less than 0.5 tonne through the vibratory roll or by a vibratory compactor approved by the Engineer. The vibrating roller shall, where required by the Engineer, be operated both longitudinally and transversely. This shall be followed by rolling with an 8 - 10 tonne tandem or other approved type of roller. Where directed by the Engineer the rolls shall be lightly wetted. Compacting shall be continued until visible movement of the surface of the layer beneath the roller ceases and until the surface is closed. The compaction shall be such that the density of the compacted base meets the requirements for density in the Clause.

Joints

At the end of each day’s work the lean concrete shall be compacted against a securely fixed vertical temporary stopend and if compaction is being done with a vibratory roller this shall be used transversely close to the stop end. In addition, the material in the corners adjacent to the stop end shall be compacted by means of a small power-operated compactor. When the stop end is removed any poorly compacted material adjacent to it shall be removed and a 1:1 cement : sand grout shall be applied to the exposed face of a thickness of 5mm - 12mm before proceeding with the laying of further adjoining lean concrete. Such fresh lean concrete shall be thoroughly compacted against the joint and where a vibratory roller is employed this shall be used transversely close to the joint again using the small power-operated compactor in the corners of the new work. None of the compacting equipment shall be allowed to bear directly on the hardened or partially-hardened lean concrete previously laid.

Curing and Surface Finish

The surface shall be formed to the lines and levels shown on the Drawings and its levels shall be within the limits specified for bases in Clause 17.17.

Except where the Engineer approves an alternative form of curing, the surface of the lean concrete shall, within one hour of being finished and compacted to the satisfaction of the Engineer, be sprayed with an approved quick-breaking 55 percent bitumen emulsion at a rate not lighter than 0.9 litre/sq. metre and blinded with medium sand.

Vehicular traffic shall be kept off the lean concrete base for 7 days after laying and thereafter the admission of traffic shall be at the discretion of the Engineer.

17.9 Waterbound Macadam Base

The base shall consist of crushed building stone mechanically laid in one or more separate layers, so as to give a total compacted thickness as shown on the Drawings, or stated in the Bills of Quantities. The first layer shall be laid to produce a thickness of 75mm to 150mm after compaction as specified. Where a greater thickness than 150mm of base is specified the material shall be laid in separate layers each not less than 75mm or more than 150mm in thickness after compaction.

The stone shall have the following gradings:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentages by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>125mm ring</td>
<td>100</td>
</tr>
<tr>
<td>75mm</td>
<td>25 - 80</td>
</tr>
<tr>
<td>38mm</td>
<td>10 - 20</td>
</tr>
<tr>
<td>20mm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

Alternatively a stone base may be placed by hand. In this case the first stones in each layer, which shall be of a cubical nature, shall be placed to the approximate height of the layer. When an area has been covered in this way a second placing of stones of smaller size shall be positioned by eye in the spaces between those first placed, and wedged home by hammering. A third placing of stones shall follow the second and so on until in the opinion of the Engineer the voids are sufficiently filled to permit compaction.

Thorough watering shall be carried out at all stages of compaction. Initial compaction shall be with a light roller. The surface shall then be blinded with quarry dust so as to fill the interstices completely and again rolled, this time using a heavy roller. The base shall then be well watered and brushed and permitted to dry. Further rolling with heavy roller, blinding with quarry dust, watering and brushing shall be carried on until the whole presents a homogenous surface and no movement is visible under the action of a heavy roller.

The levels of the surface of the course shall be within the limits specified in Clause 17.17 for bases.

17.10 Pre-mixed Waterbound Macadam Base

The base shall consist of crushed building stone mechanically laid in one or more separate layers, so as to give a total compacted thickness as shown on the Drawings, or stated in the Bills of Quantities. The first layer shall be laid to produce a thickness of 75mm to 150mm after compaction as specified. Where a greater thickness than 150mm of base is specified the material shall be laid in separate layers each not less than 75mm or more than 150mm in thickness after compaction.

The stone shall have the following gradings:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentages by Weight Passing</th>
</tr>
</thead>
</table>

SPECIFICATIONS ROADS - SUBSURFACING

SPECIFICATIONS

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SPECIFICATIONS ROADS - SUBSURFACING

50mm 100
38mm 95 - 100
20mm 60 - 80
10mm 40 - 60
5mm 25 - 40
No. 7 15 - 30
No. 25 8 - 22
No. 200 0 - 2

Wet-sieving shall be used to determine the percentage passing the No. 200 B.S. Sieve.

The graded aggregate shall be mixed with a percentage of water as directed by the Engineer depending on the type of aggregate specified within the range of 2 - 5 percent, in a mixer of a type approved by him.

The mixed material shall be protected from the weather during transit from the mixer to the site so as to prevent evaporation of moisture or further weeding of the material. It shall be laid by an approved paver or other approved plant.

Compacting shall be carried out immediately following the finisher by means of an 8 - 10 tonne roller or a vibratory tandem roller having a weight exceeding 3 tonnes. The surface of the base shall be uniformly rolled by not less than 10 passes of the roller to achieve a state of compaction such that not more than one dry density determination in 10 corresponds to an air content greater than 5 percent.

The final layer of stone shall, in addition, be compacted so as to provide a smooth and even surface free from irregularities or loose material and true to cross-section, line and level. The levels of the surface of the course shall be within the limits specified in Clause 17.17 for bases.

17.11 Drybound Macadam Base

The base shall consist of crushed building stone in one or more layers each not less than 75mm or more than 125mm in thickness after compaction so as to give the total compacted thickness shown on the Drawings or stated in the Bills of Quantities.

The aggregate shall consist of dry single sized crushed stone of 50mm or 38mm nominal size and shall be laid by spreader box or other means approved by the Engineer to an even depth which, after compaction, will produce the specified thickness of layer. After preliminary shaping with two passes of a 2.5 tonne roller or by other approved means, each layer shall be covered with a 25mm thick layer of dry crushed stone well graded from 5mm down to dust and approved by the Engineer. This fine material shall then be vibrated into the interstices of the single sized aggregate by means of an approved vibrating plate compactor or other approved vibratory plant. Should hungry patches develop during compaction additional fine material as above shall be applied and compaction of the whole surface continued until no more can be taken in. Once this stage of compaction is reached the layer shall be rolled with an 8 - 10 tonne roller until movement of the surface ceases.

All excess fine material shall be removed on completion of compacting and before the next layer of material is placed. The final layer of stone shall in addition be compacted so as to provide a smooth and even surface free from irregularities or loose material and true to cross-section, line and level. The levels of the surface of the course shall be within the limits specified in Clause 17.17 for bases.

17.12 Rock Filling Below Formation

Rock used as filling below formation level should be generally hard rock or building stone but may contain up to 50% of soft weathered rock in pieces not exceeding 200mm minimum dimension.

17.13 Bitumen Bound Base

Bitumen bound base shall be constructed on the required thickness after compaction shown on the Drawings or stated in the Bills of Quantities in layers, each of approximately equal thickness, and between 50mm and 75mm compacted thickness.

Aggregates

The aggregate shall consist of hard clean durable crushed stone complying with the requirements of British Standard 1621: Bitumen Macadam with Crushed Rock or Slag Aggregate, and subject to the approval of the Engineer.

Filler

If additional material passing the No. 200 sieve is required in the base material for compliance with the grading limits it shall consist of crushed rock, Portland cement, hydrated lime, or other material approved by the Engineer, and at least 75 percent of it shall pass a No. 200 sieve.

Binder

The binder shall be petroleum bitumen in accordance with Clause 22.33.

Composition of the Mixed Material

On analysis of the freshly mixed material its composition shall comply with Table 17.1

<table>
<thead>
<tr>
<th>BS Sieve Size</th>
<th>Percentages by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>50mm</td>
<td>100</td>
</tr>
<tr>
<td>38mm</td>
<td>95 - 100</td>
</tr>
<tr>
<td>25mm</td>
<td>75 - 90</td>
</tr>
<tr>
<td>12mm</td>
<td>60 - 75</td>
</tr>
<tr>
<td>2mm</td>
<td>30 - 45</td>
</tr>
<tr>
<td>No. 200</td>
<td>3 - 6</td>
</tr>
</tbody>
</table>

Binder content (as percentage by weight of total mixture) for 85 - 100 pen. to be 3.0 - 4.0.

Temperature of Mixed Material

The aggregate shall be surface dry, and shall be mixed within the range 110 degrees - 150 degrees centigrade so that the temperature as delivered to site and as rolled complies with Table 17.2

<table>
<thead>
<tr>
<th>Binder</th>
<th>Delivery Min. Rolling Temp. ºC</th>
<th>Temp. ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 - 100 100º - 135º 85º</td>
<td>100º - 135º</td>
<td></td>
</tr>
</tbody>
</table>

Mixing

The materials, including any added filler, shall be weighed or measured into a mechanical mixer, and thoroughly mixed in such manner that all particles of the aggregate are completely and uniformly coated.

Transport

The mixed material shall be transported from the manufacturing plant to the Site in clean vehicles, protected against adverse weather. The use of dust, coated dust, oil or water on the interior of the vehicle to facilitate discharge of the mixed material is permissible, but the amount shall be kept to a minimum, and any excess shall be removed by tipping and brushing.
Laying

The mixed material shall be laid in accordance with Clause 18.15

Compaction and Surface Finish

As soon as rolling can be effected without causing undue displacement of the material and while it has at least the appropriate minimum temperature stated in Table 17.2, it shall be uniformly compacted by an 8 - 10 tonnes roller having a width of roll not less than 450mm in accordance with Clause 17.16.

17.14 Rolled Asphalt Base

Rolled asphalt base shall be constructed in base course material complying with British Standard 594 : Rolled Asphalt (Hot Process), in layers of between 50mm and 75mm compacted thickness, each of approximately equal thickness, so as to give the required total thickness of base.

The levels of the surface of the course shall be within the limits specified in Clause 17.17 for bases.

17.15 Surface of Base

On completion of the base, and before any surfacing is laid, the finished surface shall be maintained free from potholes, ruts and undulations, irregularities, depressions, loose material or other defects, and shall comply with the requirements of Clause 17.17 for bases.

17.16 Cement Stabilised Materials for Bases and Sub-bases.

Materials to be stabilised may be naturally occurring soil, washed or processed granular material, crushed rock, an industrial waste product or any combination of these, provided that the material is free from organic contamination which would affect the setting of the cement and does not contain such a proportion of sulphates or other chemicals that the long term durability of the stabilised material will be affected.

The material shall be well-graded with a coefficient of uniformity of not less than 10 and have a grading finer than the following limited:

<table>
<thead>
<tr>
<th>BS Sieve Size</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>50mm</td>
<td>100</td>
</tr>
<tr>
<td>38mm</td>
<td>95</td>
</tr>
</tbody>
</table>

The mixed material shall be laid in accordance with Clause 18.15.

Compaction and Surface Finish

As soon as rolling can be effected without causing undue displacement of the material and while it has at least the appropriate minimum temperature stated in Table 17.2, it shall be uniformly compacted by an 8 - 10 tonnes roller having a width of roll not less than 450mm in accordance with Clause 17.16.

20mm 45
10mm 35
5mm 30
No. 7 25
No. 25 12
No. 52 5
No. 200 0

If the material is plastic it shall have a liquid limit not greater than 45 percent and a plastic limit not greater than 20 percent, as determined in accordance with British Standard 1377 : Methods of Testing Soils for Civil Engineering Purposes.

In the event of the Contractor offering a material having a grading curve falling slightly outside the limits stated in the Table, or plasticity properties slightly outside the limits given above, the Engineer may approve its use subject to his being satisfied, as a result of such tests he may require, that it meets all other requirements specified in the Clause. The material may, however, prior to its use in the works, be subject to disapproval by the Engineer, if, although having an acceptable grading or plasticity properties, it is shown during the preliminary trials to be incapable or producing a well-closed final surface to the compacted layer.

Cement and Cement content

Ordinary Portland or other approved cement to British Standard 12 : Portland Cement, shall be used. The cement content shall be such as to provide a crushing strength to the requirements stated in this Clause.

Moisture Content

The moisture content of the mixed cement stabilised material shall be determined from preliminary field compaction trials, using the mixed material, type of plant and method of operation which have been approved by the Engineer for the main work and using the optimum moisture content as determined in the laboratory compaction test using heavy compaction test using heavy compaction (British Standard 1377 : Test II) as a basis.

If water has to be added during mixing it shall be free from organic contamination and the source of supply shall be approved by the Engineer.

Method of Stabilization to be used

If the layer to be stabilized does not exceed 150mm in compacted thickness it may be constructed in one layer within the range 75mm - 150mm after compaction using either mix-in-place or stationary plant for the mixing process provided the plant meets the requirements specified in this Clause. If the course to be stabilised exceeds 150mm in compacted thickness it shall be constructed in two or more layers each within the range 75mm - 150mm in thickness when compacted. When two or more layers are employed the mix-in-place process will only be permitted for the construction of the bottom layer.

Mixing

The plant to be used for pulverising and mixing the stabilized material shall be approved by the Engineer on the basis of preliminary trials to establish that the plant is capable of producing the degree of mixing and uniformity of the stabilized material specified in this Clause. If stationary plant is used it shall be of the power-driven paddle or pan type and may be of the batch or continuous type. When mix-in-place construction is employed with plastic soils, the mixer shall be of the single-pass type and the degree of pulverization as determined in accordance with British Standard 1924 : Methods of Test for Stabilized Soils achieved in one pass shall not be less than 80 percent. With non-plastic materials both single and multi-pass equipment will be permitted.

The proportioning of the cement in the stabilised mixture shall be by weight or, if approved by the Engineer, by volume.

If batch mixers are used the appropriate measured amounts of material and cement shall be delivered into the mixer.

Water may be added during mixing to bring the moisture content of the resulting mixture to the optimum moisture content for compaction as determined by the preliminary trial. Special care shall be taken with batch type paddle mixers to ensure that the cement is spread uniformly in the loading skip so that it is fed uniformly along the mixing trough and that with both paddle and pan mixers the cement is proportioned accurately by a separate weighing or proportioning device from that used for the material being stabilized. Mixing shall be continued until the mixture has the uniformity required by this Clause and
The soil scarification will mix hard non-plastic material with plastic soil no prior scarification will be permitted unless the soil is subsequently recompressed before processing with the single-pass mixer.

The output of the mixing plant shall be such that a minimum rate of 20 metres per hour measured longitudinally of completed stabilised layer can be maintained in order to permit satisfactory compaction of the material.

The plant used for transporting the mixed material shall have a capacity suited to the output of the mixing plant and the Site conditions and shall be approved by the Engineer. All transporting plant shall be capable of discharging cleanly.

The mixed material shall be removed directly from the mixer after mixing and transported directly to the point where it is to be laid. The mixed material shall be covered during transit and while awaiting spreading to prevent it from drying or from wetting by rain. Where the stabilised material is being used to form a base layer it shall be spread and tamped evenly without delay using an approved paver to the levels and shape to give, after compaction, the specified thickness of layer and surface regularity. Where the conditions of location preclude the operation of a paver or where the material is being used for a sub-base layer, the material may be spread by any other approved method which is shown to avoid segregation of the material and which will produce after compaction the specified levels, thickness of layer and surface regularity.

Compaction

Compaction shall commence as soon as possible after the mixed material has been spread and shall be completed within a period of two hours of mixing or such shorter period as may be necessary in drying weather.

Compaction shall be carried out initially with 2 - 3 tonne smooth-wheeled roller followed by an 8 - 10 tonne smooth-wheeled roller, and finished, if necessary, with a 2 - 3 tonne smooth-wheeled roller, or the compaction can be carried out by such other means such a pneumatic-tyred or vibrating rollers, dropping weight or vibrating plate compactors as are approved as result of compaction trials. The work shall be continued in such a manner as to produce throughout the full depth of layer a relative compaction determined according to BS 1377 of at least 100 percent of the maximum density at optimum moisture content or such other relative compaction as the Engineer shall permit as a result of the preliminary compaction trials.

Where it is necessary to employ more than one layer of stabilised material, the material for each successive layer shall, subject to the following proviso, be placed and compacted within two hours of the completion of the compaction of the layer beneath. Where it is not possible to achieve this and the two-hour limit has to be exceeded, the surface of any layer remaining so exposed shall be subjected to the curing process required by this Clause.

Special care shall be taken to obtain full compaction in the vicinity of both transverse and longitudinal construction joints and the Contractor shall, if required, provide special small compactors to assist in this work. Any loose uncompacted material left in the vicinity of construction joints shall be removed prior to the placing of fresh stabilised material.

The approval of the Engineer shall be subject to each layer on completion of compaction being well closed, free from movement under the roller, from compaction planes, ridges, cracks or loose material and, within the tolerance for surface finish allowed in this Clause, true to the lines and levels shown on the Drawings. All loose, segregated or otherwise defective areas shall be broken out to the full depth of the layer and recomposed. If this cannot be carried out within the two hour limited specified, the material broken out shall be removed and replaced with freshly processed and properly compacted material.

Protection and Curing

The surface of any layer of stabilised material, unless it is to be covered within two hours by another layer of the material or other pavement course, and any exposed edges, shall be cured as soon as compaction is completed for a period of at least 7 days. Curing shall be achieved by any of the following methods:-

1. Covering the surface of the stabilised layer with an approved impermeable plastic sheeting laid so that joints in the sheeting are overlapped by at least 1 meter and held down at intervals by suitable means so that the sheets will not be blown off the layer by wind.
2. Spraying the surface of the stabilised layer with an approved quick-breaking 55 percent bitumen emulsion at a rate not lighter than 0.9 litres/m² per metre. Where it is necessary to limit heat absorption of the base, the bitumen emulsion shall, where directed by the Engineer, be lightly blinded with coarse sand or fine gravel at a rate of 6 kg/m².

3. On very small schemes where the Engineer does not require methods 1. and 2. to be used, covering the stabilised layer with at least a 75mm thick layer of suitable soil which is kept in a damp condition by periodic spraying with water during the curing period completely removed on completion of this period.

Where side forms are used in the construction of the stabilised layer they shall be firmly secured in place and not removed until at least six hours after the completion of the compaction work. The edges exposed by such removal shall be protected from drying and be cured for a period of at least seven days after construction by use of any of the methods listed above.

Construcational traffic or other vehicles shall not use any stabilised layer until it has been cured for a period of at least seven days. Thereafter, the use of the stabilised layer by traffic shall be subject to the requirements of Clause 17.18.

Joints

The Contractor shall so organise his work that longitudinal joints against hardened stabilised material are avoided as far as possible. Wherever possible in any day's work the area constructed shall extend the full width of the carriageway. At the end of each day's work on completion of compaction, the transverse edge of the layer shall if necessary be feathered out and shall be cut back vertically to the full depth of construction of the layer before work starts again. Alternatively the work may be terminated against an approved stop end. When the joint has been cut back or formed it shall be adequately protected from drying out. On resumption of work the vertical face of the joint shall be brushed to remove loose material and freshly mixed stabilised material shall be butted tightly against the previous work. Joints in the layers, where more than one layer is required, shall be staggered a distance of 1.5 - 3 metres.

Accuracy of Surface and the Thickness of Stabilized Base or Sub-Base

The surface of the completed stabilised base or sub-base shall be within the limits of tolerance of surface irregularity permitted in Clause 17.17 for surface levels of bases or sub-bases as appropriate.

Preliminary Trials

At least 10 days before the main work of stabilization is started, the Contractor shall construct an area of stabilised material of 500 - 1,000 square metres extent as stated in the Bills of Quantities as a preliminary trial at a site to be approved by the Engineer. For this trial the Contractor shall use the materials, mix proportions, mixing, laying, compaction plant and construction procedure that he proposes to use for the main work. The preliminary trial is to test the efficiency of mixing, spreading and compaction plant and the suitability of the methods and organisation proposed by the Contractor. The results of the dry density measurements made in the stabilised area will be used to confirm the moisture content and minimum state of compaction to be attained in the main stabilization work.

Crushing Strength and Uniformity of the Mixed Material

The average crushing strength at an age of 7 days for each batch of five test specimens made and tested in accordance with Clause 23.5 shall not be less than 0.28 kg/cm² per square centimetre for cylindrical samples having a height/diameter ratio of 2 : 1 or 0.35 kg/cm² for cubical specimens. If an area of stabilized layer represented by the five test specimens has an average strength less than the specified minimum value the area shall be replaced with acceptable stabilized material.

In addition to complying with the minimum specified strength, the stabilized material shall have such a uniformity that the root mean square value of the coefficient of variation of crushing strength of five successive batches of five test specimens shall not exceed 40 percent.

17.17 Surface levels of Flexible Pavement Courses and Concrete pavements

The level of any point on the surface of each of the pavement courses of the carriageway, i.e. 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 Table 17.3.

Compliance with this 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 forms, 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 ± 3 mm 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 relaxing or resetting.

In the case of the basecourse and wearing course of flexible surfacings, and the surface of concrete pavement, 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 centre line of the road, have no depression greater than the appropriate one stated in Table 17.3.

Where any surface treatment (i.e. a curing membrane or surface dressing) is applied, the specified thickness of the course or layer in question shall be regarded as including the thickness of any such surface treatment.

Rectification of Surfaces

Any surface area of any layer of the carriageway pavement where there has not been compliance with the requirements of this Clause, unless the Engineer agrees otherwise, be rectified by the Contractor, in respect of level and tolerance of surface irregularity in the following manner.

General

All high spots shall be removed down to correct level and low spots filled with material provided and laid to correct level and in all respects complying with Specification therefore including the appropriate additional requirements stated hereunder:
All material removed during rectification shall be disposed of as directed by or agreed with the Engineer.

Unless the Engineer approves otherwise, the method of construction used by the Contractor for the original work shall be adopted for the replacement of material laid in layers.

**Sub-Grade**

All low spots shall be made up with approved sub-base material or where no sub-base is specified, with approved base material.

**Sub-Base and Unbound Base**

Defective areas shall be scarified to a depth of 75mm or for the full depth of the layer, whichever is less, and corrected either by removal of material from high spots or by importation of further similar material to low spots.

**Lean Concrete Base**

Rectification shall comprise scarification, removal of the loosened material and replacement by freshly mixed lean concrete to specification.

The scarifying and removal of material shall extend for a length not less than 5.0 metres and over such width as is necessary to ensure that, without damage to the adjoining area, the surface levels are corrected to comply with the Specification. Rectification shall be effected to the depth of not less than 50mm where operations are started within one hour of the original compaction but otherwise the full depth of the layer. If the rectification is carried out within 7 days of the original compaction, not construction traffic, roller or other compacting equipment shall be allowed to use or pass on to those parts of the base which are accepted as being satisfactory as regards surface levels, except to reach the defective area by the shortest route.

**Concrete Pavement**

Testing of the concrete surface in accordance with Table 17.3 shall be carried out as soon as practicable after the final pass of the finishing machine.

If at any point the tolerance is outside the limits specified, the concrete shall, unless corrected by not more than two passes of the compacting beam, be removed to the level of the reinforcement, and be replaced with three hours of the concrete below the reinforcement having been mixed, by fresh concrete all in accordance with the Specification, including re-testing for accuracy of finish as soon as possible thereafter. If the time of removal and replacement is delayed beyond the three hours, the concrete shall be broken out to the full depth of the slab.

The area to be removed shall be that represented by the length of the straight-edge across the full width of the slab in question. Where any part of the area in default is less than 5 metres from the transverse joint, the whole area up to the joint shall be removed to the required depth. Where removal is to the full depth, at least 450mm of the reinforcement mats shall be left projecting to tie into the new concrete, any dowels or tie bars being left in their correct positions.

The accuracy of surface required by this Clause shall apply also to the surface across any joint whether formed initially or as a result of rectification.

**Bituminous Bound Base and Wearing Course of Base Course Surfacing**

<table>
<thead>
<tr>
<th>Surface of Course</th>
<th>Tolerance from true surfaced level</th>
<th>Maximum depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade</td>
<td>+ 0 - 50mm</td>
<td>-</td>
</tr>
<tr>
<td>Subbase</td>
<td>+ 0 - 38mm</td>
<td></td>
</tr>
<tr>
<td>Unbound or cement bound base i.e.</td>
<td>+ 0</td>
<td></td>
</tr>
<tr>
<td>Lean concrete</td>
<td>-25 mm</td>
<td></td>
</tr>
<tr>
<td>Bitumen bound base</td>
<td>+ 10mm - 10 mm</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

**Flexible Pavements**

<table>
<thead>
<tr>
<th>Base - Concrete Course</th>
<th>Tolerance</th>
<th>Maximum depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>On lean</td>
<td>+ 10mm</td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>+ 10mm</td>
<td>10mm</td>
</tr>
<tr>
<td>On bitumen</td>
<td>+ 6mm</td>
<td></td>
</tr>
</tbody>
</table>

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**TABLE 17.3**

**SPECIFICATIONS ROADS - SUBSURFACING**

**SPECIFICATIONS** 2/83
The requirements of this Clause shall be regarded as superseding any others relating to surface levels, tolerances of flexible pavement courses and therefore by implication, to their thickness.

The thickness of a course as shown on the Drawings, or stated in the relevant Specification clause or in the Bills of Quantities, shall be regarded as the vertical interval between the true surface of the course immediately below it.

17.18 Use of Surface by Constructional Plant

Movement and use of the constructional plant shall be subject to the following conditions:

Constructional plant shall be suitable in relation to the thickness of the pavement courses to be traversed by the plant so that the progress of the Works may not be hindered by damage to the pavement courses of the carriageway or the verges or the sub-grade material, which the Contractor, under the terms of the Contract, would be required to repair at his own cost, provided that this restriction shall not apply to the 300mm and 150mm thickness of earthworks material immediately above formation level referred to in Clause 13.6 and 13.7 respectively which shall be dealt with in accordance with the requirements of these Clauses. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious material such as mud, clay, etc.

17.19 Hand-packed Stone Base

a) Sources of Materials

The Contractor may obtain suitable material from existing commercial quarries. Before being delivered to the site of the works, the material will be tested for compliance with the requirements stipulated in the following Sub-clauses.

(b) General Requirements

The rock from which the stones and screenings are produced shall comply with the following:

Aggregate Crushing Value (ACV): Max. 30%
Los Angeles Abrasion (LAA): Max. 40%
Sodium Sulphate Soundness (SSS): Max. 12%.

(c) Stones

The stones shall be free from an excess of flat or elongated particles, soft and less durable rock, clays, loam, topsoil and other deleterious matter.

The stones shall be of such grading and size that they pack firmly when laid by hand. The larger stones shall be slightly higher than the largest and flattest end stones.

On the prepared area, individual stones shall be positioned by hand with the greatest dimension vertical, and the largest and flattest end downwards. The greater number of stones shall be slightly higher than the thickness of the layer when laid.

After placement of the stones in the specified manner, the material shall be initially compacted, preferably with a grid roller and a vibratory roller, which shall continue until the layer is thoroughly keyed, and until the compacted layer contains not more than 10% air voids.

The irregularities that may show up during compaction shall be corrected by loosening the surface and removing or adding material as may be required and re-compactd.

Where necessary, quarry fines of the same material shall be spread and broomed into the interstices and rolling shall continue until no more fines will

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**SPECIFICATIONS ROADS - SUBSURFACING**

<table>
<thead>
<tr>
<th>Bound bases</th>
<th>- 6mm</th>
<th>5mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing Course</td>
<td>+ 6mm</td>
<td>- 6mm</td>
</tr>
<tr>
<td>Base or sub-base</td>
<td>+ 0</td>
<td>- 25mm</td>
</tr>
</tbody>
</table>

**Pavements**

| Slab surface | + 3mm | 3mm |

--

**BS Sieve Size** | %Age by Weight, Passing BS Sieves
---|---
10mm | 100
5mm | 85-100
0.425mm | 30-50
0.150mm | 10-30
0.075mm | 0-20

(e) Construction

On the prepared area, individual stones shall be positioned by hand with the greatest dimension vertical, and the largest and flattest end downwards. The greater number of stones shall be slightly higher than the thickness of the layer when laid.

After placement of the stones in the specified manner, the material shall be initially compacted, preferably with a grid roller and a vibratory roller, which shall continue until the layer is thoroughly keyed, and until the compacted layer contains not more than 10% air voids.

The irregularities that may show up during compaction shall be corrected by loosening the surface and removing or adding material as may be required and re-compactd.

Where necessary, quarry fines of the same material shall be spread and broomed into the interstices and rolling shall continue until no more fines will
go in to give a homogeneous compacted layer of base.

The rate shall be the full inclusive price for providing, laying, packing and compacting the material, and shall also include for all haulage and all necessary testing for the material and the compacted layer.
PART 18 ROADS - 2

CONSTRUCTION OF SURFACINGS

18.1 Concrete and Block Carriageways Construction

Concrete, General

Two-lane concrete carriageways shall be constructed to their full width in one operation. Three-lane concrete carriageways of six lane roads shall be constructed in two widths, one slab comprising the nearside and centre lanes and the other the overtaking lane.

Where a concrete carriageway is constructed more than one slab wide, the first slab shall be constructed between two forms or a bankette and a single form as shown on the Drawings. The adjacent slab shall be constructed by replacing the flanged wheels on one side of the machine with flangeless wheels, which can travel on the surface of the concrete already completed, or on flat bottom section rails weighing at least 15 kg per metre, laid firmly on the completed concrete to support the flanged wheels. Concrete slabs or bankettes shall be at least 10 days old before they are permitted only where the concrete is not be torn or damaged when the concrete is placed.

Thickness of Slabs

The thickness at any point shall not vary more from that shown on the Drawings than is permissible by reason of the requirements of Clause 17.17 for rigid pavements.

Concrete Spreader

All concrete to be compacted by finishing machines shall be distributed with a hopper type spreader which shall have bottom gates to control the discharge of the concrete and which shall be capable of striking off concrete at the correct levels for the placing of reinforcement and for producing uniform surface.

The design of the spreader shall be sufficiently robust to ensure that the level at which the concrete is struck off is the same for both directions of travel of the hopper. Provision shall also be made for spreading to a differential surcharge across the width of the carriageway and for rapid adjustment of this differential.

Where hand-guided vibrating beams instead of finishing machines are used for compaction, the arrangements for placing and spreading concrete to a uniform surcharge shall be to the approval of the Owner.

To minimise pre-compaction, hand spreading will be permitted only where the concrete is deposited in heaps each not exceeding ¾cu. metre in size, and from a height not exceeding 750mm.

Waterproof Underlay

Waterproof underlay shall be used where shown on the Drawings. Where an overlap is necessary this shall be at least 150mm and water shall not be allowed to stand on the underlay which shall not be torn or damaged when the concrete is laid.

Setting, Checking and Striking of Side Forms

All side forms shall:

a) Be so supported that they remain rigid at all times. They shall at any point be set in position at least 30 hours before concrete is placed between them. Forms shall be cleaned and oiled each time before they are used.

b) Be bedded directly on a strip of concrete or mortar of thickness within the range 25-50mm as shown on the Drawings and of the width of the forms base so as to ensure the necessary complete rigidity and stability. The base, or where none is specified, the formation on the line of the forms shall be thoroughly compacted before the forms are set.

c) Be as specified set to line and secured by using not less than three pins for each 3 metre section, one being placed at each side of every joint or as otherwise approved by the Owner.

For concrete to be compacted by vibrating screeds the setting of the forms shall be such as to provide the accuracy of finish specified in Clause 17.17 for concrete pavements.

If corrections are necessary as a result of checking for conformity with the alignments and levels shown on the Drawings such correction shall be made at least 20 hours before any concrete is placed between them. Where any form has been disturbed it shall be reset and checked. Side forms shall be removed not less than 12 hours after completion of the construction of the concrete road slabs or after such longer time as the Owner may require to avoid damage to arise. Care shall be taken that the concrete and any projecting time rods are not damaged in any way during the removal of the forms. Any concrete or mortar bed projecting above the level of the bottom of the slabs shall be removed at the same time and the sub-grade and base made good to the satisfaction of the Owner.

Quantity and Distribution of Steel Reinforcement

The quantity and distribution of reinforcement shall be as shown on the Drawings, with such modifications as may be necessary and approved by the Owner to suit manholes and surface boxes, juctions or slabs of different width or length. No loose roads or small pieces of fabric other than as provided for in the Specification shall be permitted in any portion of the work.

All reinforcement for carriageways and structural work shall when placed in position be free from loose rust, mill scale or other substances which might prevent proper adhesion to the concrete.

Placing Of Steel Reinforcement

Steel fabric reinforcement for carriageways shall be as specified. The reinforcement shall be so placed that after compaction of the concrete it is in the position shown on the Drawings and shall terminate 38mm from the edges of all joints in the concrete unless otherwise specified.
Treatment At Manholes

Manholes shall be housed in separate small slabs, which shall be the size of the exterior of the shaft and shall be formed by casting the main slab against boxes of this size, made from framework and accurately placed vertically above the exterior of the shaft. This formwork shall be removed at the same time as the reminder of the formwork for the slab. Expansion joint filler 10mm wide shall be placed against the exposed edges of the slab, and reinforcing bars as specified in Clause 14.3 an if shown on the Drawings shall be placed accurately in position so as to give the required final cover, concrete being placed by hand in the space intervening between the slab and the manhole frame. The concrete shall then be compacted to the same density as that of the adjoining slab.

A groove shall be formed at the top of the joints with the surrounding slab and sealed, in accordance with the requirements of this Specification, the top arises of both slabs being rounded to radius of 6mm.

Joints In Concrete Carriageways, General Requirements

All joints shall be constructed by methods approved by the Owner, and with vertical faces. Grooves in the surface of the concrete over joints shall be sawn except that alternative methods of forming the grooves may be submitted and may be considered by the Owners in lieu of a sawn groove provided that the Contractor demonstrates to the Owner’s satisfaction that the surface finish so obtained is within the appropriate tolerance permitted in Clause 17.17.

Transverse Joints

Expansion joints shall comprise preformed joint filler, dowel bars and supporting cradles. The joint filler shall be soft-wood, free from knots, or other approved material complying with the requirements of the relevant Clause and of sufficient rigidity to enable it to be satisfactorily installed in the joint and resist deformation during the passage of the concreting train. The joint filler together with the sawn groove, shall provide complete separation of adjacent slabs. The dowel-bars shall be provided at mid-depth of the slab, parallel to the finished surface and to the centre line of the road within a tolerance of ±5mm in 1 metre.

The supporting wire cradles shall be made from welded wire fabric having a 150mm square mesh and wires not smaller than 5.5mm diameter. The joint filler, dowel-bars and supporting cradles shall be wired together so as to form a rigid assembly which will not become distorted during handling on the Site or during concreting operations.

Dowel-bars shall be provided at one end with closely fitting sleeve 100mm long consisting of waterproof cardboard or other approved material. A loose plug equal in thickness to the width of the expansion joint, and consisting of cotton waste or a disc of expansion joint filler, shall be inserted within the sleeve at the end of the dowel-bar. The free half of each dowel shall be greased or painted with joint priming compound. The method of assembling and securing joints shall be approved by the Owner.

Where contraction joints are required these shall be formed by a groove sawn in the surface of the hardened concrete and an approved filler cast into the bottom of the slab, all as shown on the Drawings. The sawn groove shall be located vertically above the filler to within a tolerance of ±12mm. Dowel-bars shall be provided as for expansion joints except that a sleeve at one end is not required. The dowel-bars and timber fillet shall be supported by a wire cradle which shall be similar to that specified for expansion joints in respect of both materials and method of assembly. The tolerance on the alignment of dowel-bars in contraction joints shall be similar to that specified for expansion joints.

Construction joints shall be installed only under the conditions specified herein. They shall be formed by means of a drilled and split cross-form which shall allow the specified tie bars to be inserted and which shall permit the reinforcement to project through the joint for a distance of at least 375mm. On recommencing work the cross-form shall be removed and the vertical face of the concrete roughened. The next reinforcing mat shall completely overlap the projecting reinforcement.

Joints shall be formed in a straight line at right angles to the longitudinal axis of the carriageway except where this cannot be achieved as at road junctions and roundabouts and corresponding joints on either side of a longitudinal join shall be in line with each other.

Sealing Of Joints

Any dust, grit, or temporary protective material shall first be removed from the grooves which shall, if necessary, be dried immediately proper to permanent sealing.

Unless otherwise directed by the Owner, the dried joints shall then be sealed with a compounding complying with this specification. Hot poured sealing compound shall be heated in an indirectly heated melter-pourer to a temperature within the recommended pouring range stated by the manufacturer and shall not be heated at this temperature for a period longer than the safe heating time stated by the manufacturer. The melter-pourer shall be cleaned out at the end of each day’s work and material which has been once heated and allowed to cool shall not be reheated or mixed with fresh material. Joints shall be filled so that the sealing compound is flush with the carriageway.

Where specified two-component cold-applied compound complying with US Federal Specification SS-S-170 shall be used in accordance with the recommendations of the manufacturer.

Compressive Strength Of Concrete

During the whole progress of concreting, test cubes shall be made in the manner described in Clause 14.6 Not more than 1 percent of cubes tested shall show a strength of less than 2.8 kg/sqmm at 28 days.

If rapid-hardening cement is used, reference in this Clause to 28 days, which is the period for ordinary Portland cement, shall be the period between concreting and opening to traffic.

Cubes shall be made each day in pairs at intervals, each pair being from a different batch of concrete. At the start of the work, and until such times as the Owner may order a reduction in the number of cubes required, six pairs shall be made each day, one of each pair for testing at 28 days for determination of the maximum permissible crushing strength and the other for testing at an early stage for the information of the Owner as to the quality of the stage for the information of the Owner as to the quality of the mix. When the first thirty results are available and for so long as the Owner is satisfied with the quality of the mix, he may reduce the number of cubes required to two pairs each day.

After it has been established that the specified crushing strength is being regularly obtained or exceeded as provided that the source of the quality of the materials remain constant, the Owner may waive the making of cubes for testing at an early stage. One cube from each of two batches of concrete shall be made each day for testing at 28 days.
If the minimum crushing strength of 2.8 kg/sq mm is not so attained the Contractor may without expense to the Employer, cut cores from locations selected by the Owner. Where this is done the strength of cores when tested in accordance with British Standard 1881: Methods of Testing Concrete, will be accepted as taking precedence over the cube strengths if not less than 2.1 kg/sq. mm at 28 days will be accepted for a core having a height/diameter ratio of 2.

The method which shall be adopted for correcting the strength of curves and cores for age is given in Appendix III. In order to check the depth of concrete laid, the state of compaction and the position of the reinforcement, the Owner may order cores to be cut.

The unit prices to be inserted by the Contractor in the Bills of Quantities shall include for preparing, cutting packing and transporting cubes and cores required by the Owner. In addition, for cores the price shall include for all costs incurred in connection with drilling and making good to the satisfaction of the Owner.

Grading Of Aggregates

The grading of the aggregates shall be within the limits of British Standard 882: Concrete Aggregate from Natural Sources. Once the appropriate grading, including the grading zone of the fine aggregate, has been determined and approved, it shall not be varied without the permission of the Owner.

Consistency Of The Mix

The cement and the coarse and fin aggregate shall be as specified in Section 14 of this specification. The maximum size of aggregate shall be either 20mm or 38mm as stated in the Bills of Quantities. The aggregate cement ratio shall not exceed 7:1 by weight. Rapid hardening Portland cement used in the construction of carriageways shall be batched by weight. Rapid hardening Portland cement aggregate cement ratio shall not exceed 7:1 stated in the Bills of Quantities. The maximum size of aggregate cement ratio shall not exceed 7:1.

Water Cement Ratio Of Concrete

The ratio of free water to cement for saturated surface-dry aggregate shall not exceed 0.55 by weight for all concrete in carriageways.

Limit Of Workability

The concrete shall be of suitable workability for full compaction to be obtained with the equipment used and without undue flow.

When the optimum value of the compacting factor has been determined and approved by the Owner for the mix and plant being used, that value shall be maintained within at tolerance of ±0.03.

Proportioning The Mix

Unless an integral number of bags of cement is used the cement shall be weighed. The proportions of sand and aggregate shall also be gauged by weight, allowance being made for the weight of moisture in the aggregate. Each size of fine and coarse aggregate shall be batched by weight, allowance being made for the weight of moisture aggregate. The weight of cement, the total weight of fine aggregate and the total weight of coarse aggregate shall each be within a tolerance of ±2 percent of the weight specified.

Placing Concrete

When concreting of a slab has commenced no cessation of the work will be allowed until concreting of the slab is completed. In the event of mechanical breakdown or adverse weather, however, the Owner may permit the use of a construction joint.

The placing, compacting and finishing of the concrete shall be carried out as rapidly as possible and operations shall be so arranged that in any transverse vertical section the concrete shall be fully compacted throughout the whole depth and finished within 1.5 hours from the time for the completion of the mixing of the first batch of concrete in that section. The period shall be 1 hour whenever cement entering the mixer exceeds 66°C in temperature.

Curing Concrete

Immediately after the concrete surface has been finished the concrete shall be cured by treating with an approved resinous curing compound. It shall be mechanically sprayed on to the surface at the rate of 0.22 to 0.27 litre/sq metre using a fine spray. Care shall be taken to apply the compound uniformly. Any groove over a joint shall be protected from the entry of liquid curing compound. The concrete shall then be protected against the effects of sunshine an rain during setting by tents consisting of frames running on the rails and covered with an approved opaque and waterproof material of white colour on the outside and arranged so that it will shed any water clear of the fresh concrete. The concrete shall be covered by the tents for such period as the Owner shall direct which will be not less than 2 hours.

Where white concrete road markings are used in the surface, these shall be cured by an approved curing compound which does not discolour the white concrete.
Traffic Over Finished Work

No vehicular traffic shall be allowed on the finished surface within 20 days of its completion where ordinary Portland cement is used or 10 days where rapid-hardening cement is used and until the joints have been permanently sealed unless otherwise authorised by the Owner.

Such authorisation will be given only when all joint grooves have been protected temporarily by a method approved by the Owner to prevent the ingress of foreign material.

Concrete Block Paving

Where required, areas to be paved with concrete blocks shall be in 210mm x 105mm x 80mm thick natural grey, coloured concrete paving blocks from approved manufacturers.

The paving blocks shall be laid as specified by the manufacturers. Generally the specification is as follows:

- Provide a compacted murrum sub-base with thickness shown in the drawing
- Spread a 50mm thick layer of well graded sand with not more than 10% sand retained on 5mm mesh sieve over the compacted murrum base
- Lay the concrete paving blocks over bed of sand in a Herring-bone pattern and joint with mortar. The paving slabs shall be vibrated to their finished bedding level using three passes of a plate vibrator. The plate of the vibrator shall have a centrifugal force of 10N or 12N and plate area of 0.3M2.
- Brush sand over the surface of the paving blocks after the initial vibration
- Precast concrete kerbs and channels blocks shall be provided as shown in the drawing.

18.2 Rolled Asphalt (Hot Process) Wearing Course

Rolled Asphalt wearing course shall be made and laid (subject to the requirements of Clause 17.17 in respect of levels and tolerance of irregularity for wearing course) in accordance with British Standard 594 : Rolled Asphalt (Hot Process). Composition of the mixed material shall comply with Table 18.1, Mix Ref. E. Temperature requirements shall be as detailed in Table 18.2, Mix Ref. E. The thickness after compaction shall be as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable, the rolled asphalt shall be laid using an approved paver.

Where a basecourse has been used as part of the surfacing, the wearing course shall be laid thereon as soon as practicable, care being taken that the latter is thoroughly clean. In any case the wearing course should be laid within 3 days of the laying of the base-course, unless the Owner allows otherwise, and no construction or other traffic shall be allowed on the base-course.

18.3 Dense Bitumen Macadam Wearing Course

Dense bitumen macadam course shall be made and laid (subject to the requirements of Clause 17.17) in accordance with British Standard 1621 : Bitumen Macadam with Crushed Rock or Slag Aggregate. Composition of the mixed material shall comply with Table 18.1, mix Ref. A or C, all as shown on the Drawings or stated in the Bills of Quantities. Temperature requirements for the respective mixes shall be as detailed in Table 18.2, Mix Ref. A or C. The thickness after compaction shall be as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable, the bitumen macadam shall be laid using an approved paver. Coated chippings shall be applied if required.

The provisions of Clause 18.2 in respect of elapsed time between the laying of the base and wearing courses, and traffic, shall apply to this Clause.

The maximum mixing temperature for straight run bitumen of penetration 85 - 100 is 160°C. For other penetration bitumens it shall be as determined by the Owner.

18.4 Bitumen Macadam Wearing Course

Bitumen macadam wearing course shall be made and laid (subject to the requirements of Clause 17.17) in accordance with British Standard 1621 : bitumen Macadam and Crushed Rock Slag Aggregate, using the appropriate Table and Section(s) thereof, other than those for Dense Bitumen Macadam, and nominal size of aggregate all as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable the bitumen macadam shall be laid using an approved paver. The maximum mixing temperature for straight run bitumen of penetration 85 - 100 is 155°C. For other penetration bitumens it shall be as determined by the Owner.

18.5 Cold Asphalt

Cold asphalt wearing course shall be made and laid (subject to the requirements of Clause 17.17) in accordance with British Standard 1690 : Cold Asphalt. Composition of the mixed material shall comply with Table 18.1, Mix Ref. D. Temperature requirements shall be as detailed in Table 18.2, Mix Ref. D. It shall be laid in a single course ranging in thickness from 12mm to 25mm after compaction as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable asphalt shall be laid using an approved paver. Coated chippings shall be applied if required.

18.6 Open Textured Bitumen Macadam Base-Course

Open textured bitumen macadam base-course shall be made and laid (subject to the requirements of Clause 17.17) in accordance with British Standard 1621 : Bitumen Macadam with Crushed Rock or Slag Aggregate, using the appropriate Table and Section(s) thereof and nominal size of aggregate as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable the bitumen macadam shall be laid using an approved paver.

The maximum mixing temperature for straight run bitumen of penetration 85 - 100 is 150°C. For other penetration bitumens it shall be as determined by the Owner.

18.7 Dense Bitumen Macadam Base-Course

Dense bitumen macadam base-course shall be made and laid (subject to the requirements of Clause 17.17) in accordance with British Standard 1621 : Bitumen Macadam with Crushed Rock of Slag Aggregate. Composition of the mixed material shall comply with Table 18.1, Mix Ref. A or B. Temperature requirements shall be as detailed in Table 18.2, Ref. A or B. The thickness after compaction shall be as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable the bitumen macadam shall be laid using an approved paver.

Compaction and Surface Finish

As soon as rolling can be effected without causing undue displacement of the material, and while the material is above the minimum temperatures stated in Table 18.2, it shall be uniformly compacted by an 8 - 10 tonne roller having a width of roll not less than 450mm in accordance with Clause 18.18.
18.8 Blinding of Open Textured Bitumen Macadam Surfacing

Where any course of bitumen macadam (other than dense bitumen macadam wearing course) is to be used as a permanent or temporary running surface it shall be blinded and/or surface dressed in accordance with Clause 18.13.

The blinding shall be carried out as directed by the Owner, using approved bitumen coated grit not exceeding 3mm nominal size, or fine cold asphalt in accordance with British Standard 1690 : Cold Asphalt. The rate of coverage of either material shall be as directed by the Owner.

(Table 18.1 and Table 18.2 - next page)

18.9 Rolled Asphalt Base-Course

Rolled asphalt base-course shall be made and laid (subject to the requirements of Clause 18.15) in accordance with British Standard 594 : Rolled asphalt (Hot Process), and the thickness after compaction shall be as shown on the Drawings or stated in the Bills of Quantities. Except where impracticable, the rolled asphalt shall be laid using an approved paver.

18.10 Marshall Asphalt (Asphaltic Concrete) Design Mix

Asphaltic concrete shall be made and laid (subject to the requirements of Clause 17.17 in respect of levels and tolerance of irregularity for wearing course and base course) in accordance with British Standard 594. Temperature requirements shall be as detailed in Table 18.2, Mix Ref. E. The thickness after compaction shall be as where impracticable, the rolled asphalt shall be laid using an approved paver.

Where a basecourse has been used as part of the surfacing, the wearing course shall be laid thereon as soon as practicable, care being taken that the latter is thoroughly clean. In any case the wearing course should be laid within 3 days of the laying of the base-course, unless the Owner allows otherwise, and no construction or other traffic shall be allowed on the base-course.

The asphalt mixture will be designed in accordance with this specification, which makes provision for the use of aggregate of pre-determined grading together with adequate bitumen to meet the specified requirements.

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**SPECIFICATIONS ROADS — SURFACING**

Marshall Strength and stability criteria as laid down in BS 594.

The binder shall be of grade 80/100 penetration or as ordered in writing by the Owner.

The mineral aggregate shall have a smooth grading curve approximately parallel to the grading envelope/unit specified in BS 594, or as ordered in writing by the Owner.

The Contractor shall submit samples of the aggregate and bitumen binder he intends to use in the mix to the Owner at least one month before he commences with the surfacing work, so that the Owner may test and decide on the proportions of the actual working mix.

The working mix shall comply with the following requirements for the Marshall Stability Test, ASTM, D.155965T, based on 75 blow compaction of specimens - Marshall Stability lbs, 800 min. Flow value (1/100") 8 - 16; voids in total mix % by weight, 3 - 5.

When the composition of the design mix has been established by the Owner, the Contractor shall maintain the composition of the working mix within the following tolerances from the design mix:

a) Bituminous binder, from onetest: design mix % ± 0.4

b) Bituminous binder, from a series of five or more tests: design mix % ± 0.2

c) Aggregate passing 3/16" sieve: design mix % ± 6

d) Aggregate passing No. 36 sieve: design mix % ± 5

The Owner shall have the right to take samples of the actual mix and of the ingredients as often as he considers necessary in order to determine whether specified requirements are being conformed with.

The Contractor is expected to carry out the running control of the mix in order to maintain the composition within the tolerances specified.
SPECIFICATIONS ROADS – SURFACING

Table 18.1

<table>
<thead>
<tr>
<th>Mix Ref.</th>
<th>Description</th>
<th>Nom. Size</th>
<th>Range of compacted Thickness mm</th>
<th>Binder</th>
<th>Grading (Percentage passing B.S. Sieve)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grade</td>
<td>% of Total Mix</td>
</tr>
<tr>
<td>A</td>
<td>Dense bitumen macadam base course and wearing course</td>
<td>19</td>
<td>30 – 50</td>
<td>80/100</td>
<td>4.71+ - 0.5</td>
</tr>
<tr>
<td>B</td>
<td>Dense bitumen macadam base course</td>
<td>25</td>
<td>50 – 63</td>
<td>80/100</td>
<td>4.71+ - 0.5</td>
</tr>
<tr>
<td>C</td>
<td>Dense bitumen macadam wearing course</td>
<td>13</td>
<td>19 – 25</td>
<td>80/100</td>
<td>4.91+ - 0.5</td>
</tr>
<tr>
<td>D</td>
<td>Fine cold asphalt</td>
<td>No. 7</td>
<td>13 – 25</td>
<td>MC250</td>
<td>6.01+ - 0.5</td>
</tr>
<tr>
<td>E</td>
<td>Hot rolled asphalt wearing course</td>
<td>12</td>
<td>25 – 30</td>
<td>60/70</td>
<td>8.51+ - 0.5</td>
</tr>
<tr>
<td>F</td>
<td>Dense bitumen macadam road base</td>
<td>37</td>
<td>50 – 100</td>
<td>80/100</td>
<td>4.01+ - 0.5</td>
</tr>
</tbody>
</table>

Table 18.2

<table>
<thead>
<tr>
<th>Mix Ref.</th>
<th>Tempatures degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Binder</td>
</tr>
<tr>
<td>A</td>
<td>149 – 163</td>
</tr>
<tr>
<td>B</td>
<td>149 – 163</td>
</tr>
<tr>
<td>C</td>
<td>149 – 163</td>
</tr>
<tr>
<td>D</td>
<td>As directed by the Engineer</td>
</tr>
<tr>
<td>E</td>
<td>163 – 177</td>
</tr>
<tr>
<td>F</td>
<td>149 – 163</td>
</tr>
</tbody>
</table>

18.11 Preparation of the Base for Surfacing or Surface Dressing

Before any binder or coating is applied to a base the latter shall have been freed from all extraneous material by brushing with mechanical sweepers or stiff brooms.

Macadam or murrum base shall normally receive a priming coat in accordance with Clause 18.12.

Concrete, bitumen bound or rolled asphalt bases shall normally receive a tack coat in accordance with Clause 18.13.

18.12 Prime Coat

When a base is to be sealed before surfacing by means of a prime coat, the surface shall first be prepared in accordance with Clause 18.11.

Unless otherwise stated in the Bills of Quantities or ordered by the Owner, the prime coat material shall be bitumen grade M.C.O. at a rate of application of 1.2 - 1.5 litre/sq. metre. It shall be applied with a mechanical bitumen distributor complying with the requirements of British Standard 1707 : Binder Distributors for Road Surface Dressing.

The prime coat shall be cured for 48 hours. This period may be relaxed at the discretion of the Owner who shall be informed and shall give his consent before any surfacing works are commenced.

The Contractor shall not permit traffic to run on a prime coat. Where this is unavoidable the Owner shall order an application of medium sand at a rate of 6 kg./sq. metre which item shall be measured and paid for separately.

18.13 Tack Coat

Where adhesion of an existing surface is to be improved before surfacing by means of a tack coat, the surface shall first be prepared in accordance with Clause 18.11.

Unless otherwise stated in the Bills of Quantities or ordered by the Owner, the tack coat material shall be approved bitumen emulsion in accordance with British Standard 434 : Bitumen Road Emulsion, containing not less than 55% of bitumen. It shall be mechanically applied at a rate of 0.38 - 0.43 litre/sq. metre.

The tack coat shall be allowed to cure to a tacky condition and the Owner’s consent obtained before any surfacing works are commenced. Any ponding which has occurred must be brushed out to bring the coverage within the limits specified.
The Contractor shall not permit traffic under any circumstances to run on a tack coat.

**18.14 Surface Dressing Using Hot Bitumen**

This Clause shall apply to surface dressing applied to a new base as a permanent or temporary surface and to an existing road surface. Surfaces to be dressed shall be classified by the Owner as 'hungry', 'normal' or 'rich', and according to traffic density and the rates of spread of binder and aggregate shall be as specified in Tables 18.3 and 18.4.

Hot bitumen, as specified in Clauses 26.33 and of the grade stated in the Bills of Quantities, shall be evenly applied to the surface by means of a distributor complying with British Standard 1707 : Binder Distributors for Road Surface Dressing, which shall have been calibrated for rate of spread within the preceding 6 months. The temperature of application of the bitumen measured by a reliable thermometer fitted to the distributor shall be within the range 145°-205°C for straight run bitumen of penetration 85 - 100. For other penetration bitumens it shall be as determined by the Owner. Immediately after spraying the bitumen shall be covered with a layer of clean crushed road aggregate as specified in Clause 22.36 which shall then be rolled with a pneumatic tyred roller weighing 6 - 10 tonnes, rolling being continued until a uniform, compact surface has been obtained (the use of other types approval). As far as practicable traffic should not be permitted to use a newly dressed surface until the bitumen has acquired a preliminary set, particularly in hot weather. If this if not practicable, appropriate sign posts shall be erected restricting traffic speed to 30 kph for a period of 24 hours.

The rate entered in the Bills of Quantities shall also cover the initial preparation of base or existing road surface (but not any prime or tack coat) and the sweeping up and removal of all surplus aggregate within 14 days of the completion of the work.

The Contractor shall be responsible for control of the rates of spread and laying temperatures in order to ensure that the surface dressing complies with these requirements. Returns indicating the area covered and the quantity of chippings and bitumen used shall be made to the Owner the following day.

At all transverse joints with new or existing work suitable mats shall be laid below the distributor nozzles and extended beyond the apron which, upon removal, shall ensure that a neat clean joint is made free from surplus bitumen.

The matching longitudinal joints nozzles shall be cut off to give the appropriate spraying width in each lane. Caps or overlaps between lanes will not be permitted. Kerbs, channels, gullies and all covers shall be adequately protected.

**18.15 Regulating Course**

Regulating course, consisting of a base-course or wearing course material complying with the appropriate Clause, shall be laid and compacted to provide a smooth or even surface, free from loose material and true to cross-section, line and level within the tolerances specified in clause 17.17 for the base or base-course being regulated.

**18.16 Mechanical Laying of Surfacing Materials**

Unless otherwise approved by the Engineer all asphalt and macadam surfacings shall be laid by an approved self-propelled mechanical paver. The machine shall be wholly in good working order, with fully operating feeder bars, spreading screws, tamper bar and hearted screed plate. It shall be operated by a man fully trained and experienced in the use of that particular machine. The line and level controls appropriate to the machine shall be employed at all times unless the Owner in writing allows otherwise. The necessary attachments must be available, and when required, to ensure that the laying width can be varied from 1.8 to 3.6 metres. Removal of end plates to allow bleeding out will only be permitted after consultation with the Owner. The pattern of laying must be agreed by the Owner and any run of lesser width must be laid first to avoid the paver running on freshly laid material.

The Contractor is responsible for controlling the rate of material to ensure that the thickness and profile shown on the Drawings or stated in the Bills of Quantities are complied with. Underlay will be paid for only on the prior written permission of the Owner. The material must be supplied as far as possible continuously to the paver. Where stoppages make specified temperatures or delivery or rolling unobtainable, the hopper of the machine shall be emptied of all cold material, and a joint formed in the surfacing course in accordance with Clause 18.17.

The exposed edges of channel blocks, gullies and manhole shall be brushed clean and painted with hot binder prior to the passage of the paver. All covers shall be adequately protected and suitable roadside markers should be provided to prevent these being permanently covered by surfacing material.

Returns indicating the area covered and the quantity of surfacing material used shall be made to the Owner the following day.
SPECIFICATIONS ROADS — SURFACING

Table 18.3
Rate of Spread of Binder in Litres/sq. metre

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>HUNGRY</th>
<th>NORMAL</th>
<th>RICH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic in Vehicles, 1,000 /day</td>
<td>Up to 10,000</td>
<td>10,000</td>
<td>Over 10,000</td>
</tr>
<tr>
<td>20mm</td>
<td>Not Recommended</td>
<td>12mm</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>0.97</td>
<td>0.92</td>
<td>0.91</td>
</tr>
<tr>
<td>6mm</td>
<td>0.97</td>
<td>0.81</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Table 18.4
Rate of Spread of Chippings in Kg/sq. metre

| Traffic in Vehicles, 1,000 /day | Up to 10,000 | 10,000 | Over 10,000 | Up to 10,000 | 10,000 | Over 10,000 |
| 20mm | 16 | 19 | | | | |
| 12mm | 14 | 16 | | | | |
| 9mm | 11 | 14 | | | | |
| 6mm | 7 | 9 | | | | |

18.17 Joints in Surfacing Courses

No longitudinal joints shall be left exposed at the end of a day’s work. If this is unavoidable, the joint shall be cut back to a vertical face and pointed with hot binder before the adjoining surfacing is laid. In the case of hot rolled asphalt surfacing, this procedure shall be followed for all joints whether warm or cold formed.

Longitudinal joints in different courses shall be staggered transversely at least 300mm.

18.18 Rolling of Surface Materials

The type of weight of roller to be employed on each course of surfacing shall be approved beforehand by the Owner. Notwithstanding the Owner may call for a certified weighbridge ticket in respect of any roller at any time.

Roller wheels shall always be clean and even. An adequate water tank shall be provided together with a fully operating roller sprinkler system. The roller shall be operated by a man fully trained and experienced in rolling technique.

Rolling shall be generally carried out in a longitudinal direction, working from the edge of the carriageway to the crown or, in the case of a superelevated carriageway, from the low to the high side. The second pass should be precisely on the path of the first, before the roller shift transversely. Heavy drives wheels should approach the freshly laid material. Reversing should be carried out slowly and smoothly and the reversing points staggered across the carriageway to avoid any wave effect. Rolling should be continued until all marks are eliminated and there is no perceptible movement under the roller wheels.

Idle standing on freshly laid material is not permitted.

If the total area of surfacing to be compacted exceeds 3,000 sq. metres per day, the Contractor shall provide a second roller.

In confined areas where normal rolling is not possible, mechanical tamping will be permitted. The tampers must be employed systematically to give a smooth “as-rolled” finish.

No traffic will be permitted on a surfacing course until it has been compacted and in the opinion of the Owner has acquired a sufficient set.

18.19 Grass

This Clause deals with the planting of grass on side-slopes and verges, and other parts of Owning sites as required by the Drawings or Bills of Quantities.

The area to be planted should be cleared of all rubble, weeds, surplus material and other rubbish. The soil shall then be well dug to a depth of 225mm and all lumps of soil broken down. If it is necessary to import soil to replace that removed during construction, it shall be rich red soil and sufficient should be brought to provide a 75mm layer over the area concerned.

or, if mixed with the existing soil, to form 50% of the top 75mm of the mixed soil.

The grass should be regularly weeded during the maintenance period and be delivered up weed-free at the end of this time.

KERBS, CHANNELS, QUADRANTS, EDGINGS, CUT-OFF WALLS, PAVING FLAGS AND TRAFFIC SIGNS

18.20 Precast Concrete Kerbs, Channels and Quadrants

Precast Concrete Kerbs, Channels and Quadrants shall be as specified in Clause 22.38. All concrete carriageways slabs, kerbs and quadrants shall, where shown on the Drawings, be laid and bedded in a 12mm layer of cement mortar, as specified in Clause 22.10.

For other than concrete roads, the concrete kerbs, channels and quadrants shall be laid and bedded on the 12mm layer of cement mortar (1:3) as specified in Clause 22.10. No joint shall exceed 12mm in width.

Dowelled kerbs used with cut-off walls shall be laid and bedded on a 12mm layer of cement mortar (1:3) as specified in Clause 22.10. The holes shall be filled with cement mortar in two stages, the last 12mm of depth being added two days after the bulk.

Specially cast circular kerbs and quadrants shall be used on curves where the radius is 20 metres or less. Expansion joints where shown on the Drawings or directed by the Owner shall be constructed in line with expansion joints in the carriageway.

All kerbs, channels and quadrants shall be laid true to line and level and any unit found to be more
than 3mm out of the line or level at either end shall be lifted and relaid.

18.21 Precast Concrete Edging

Precast concrete edging shall be as specified in Clause 11.38 and shall be set and jointed as shown on the Drawings or as directed by the Owner. When completed it shall be true to line and level and any unit found to be more than 3mm out of line at either end shall be lifted and relaid. The price inserted in the Bills of Quantities shall include for any necessary excavation and refilling required in connection with the setting of the edging and the disposal of surplus material.

18.22 Concrete Bedding and Concrete Haunching for Precast Kerbs and Quadrants

Concrete bedding and concrete haunching for precast kerbs and quadrants shall be constructed to the dimensions shown on the Drawings or as directed by the Owner and shall consist of concrete of the appropriate Class. The price included in the Bills of Quantities shall include for all formwork, excavation and disposal of surplus material.

18.23 Cut off Walls

Where required, concrete cut-off walls shall be constructed from concrete of the appropriate Class specified to the dimensions shown on the Drawings. The concrete shall be mixed, sampled, transported, placed, compacted and cured according to the Structural Section of the Specification.

Kerb dowels 12mm diameter and 300mm long shall be accurately set 150mm into the wall at 450mm nominal centres and cast in. Kerbs may be cut only adjacent to outlet drains. Construction joints in accordance with Clause 9.31 shall be provided where directed. The inner face of the wall shall be cast against the trimmed face of the trench, but formwork will be required, where the wall projects above existing ground level. The outer face shall be shuttered. After seven days the outer face shall receive an application of bitumen of 85/100 penetration applied by means of an approved hand-spray distributor at a rate of application of 0.54 litre/sq. metre and at a temperature of 170°C - 180°C.

The rates for cut-off walls shall include for all excavation including working space, formwork, all materials, bitumen application including a coating on all pipes and conduits passing through the wall, and back-filling with approved excavated materials.

18.24 Precast Concrete Flag Paving

Precast concrete flags shall be as specified in Clause 22.39, and shall be laid on 50mm concrete of the appropriate Class specified over a 75mm bed of murram as specified in Clause 22.8. The slabs shall be laid to a regular 150mm or 300mm bond as directed, with joints at right angles to the line of the kerb. The prices for laying paving shall include all cutting whether straight or circular, bedding in with fine sand and grouting with mortar (1:3).

18.25 Murram Footways

Murram footways shall consist of 100mm of compacted murram as specified in Clause 22.8 laid to the levels and falls shown on the Drawings on a well-compacted sub-grade.

18.26 Permanent Traffic Signs

Permanent traffic signs shall be either externally or internally illuminated, reflectorised or non-reflecting and shall conform in quality of British Standard 873: The Construction of Road Traffic Signs and Internally-Illuminated Bollards. They shall have the dimensions, and legends, and be of the material and finish, including any illumination or reflectorisation, shown on the Drawings or stated in the Bills of Quantities.

Where illumination is to be provided this shall be tungsten filament or fluorescent type, as shown on the Drawings or stated in the Bills of Quantities and complying with the British Standard.

Traffic signs shall be erected with suitable fittings on posts made from tubular steel, reinforced or prestressed concrete or timber, all as shown on the Drawings or stated in the Bills of Quantities and complying with the British Standard.
19.1 GENERAL

The Contractor shall supply all paints, primers, varnishes, distemper, oil, etc. ready mixed in original sealed containers bearing the brand maker’s name identifying the contents and giving directions for its proper use.

Painting materials shall be of the best quality products of recognised manufacturers, and shall be subject to the approval of the Architect. The quality of the finishing colours shall be capable of giving three years’ minimum satisfactory performance under tropical conditions with high temperatures and humidity, and capable of withstanding temperatures of up to 60 Deg. C for long periods without colour change. Paints shall also be resistant to oils, acids and alkalies.

All surfaces to be painted shall be adequately cleaned and prepared to the satisfaction of the Engineer’s Representative and shall be dry and free from any oils, greases, stains or other marks prior to being painted. The paint shall be well and evenly applied. Where sprays are used, markings of the edges of the painted area shall be carried out to provide a definite edge. Brushes and sprays shall be the correct size and type for the work being executed.

For painting applied in several coats each coat shall be of a different shade or colour from the others. Each coat shall be allowed to dry thoroughly and sufficiently harden before the next coat is applied.

All colours shall be selected and approved by the Architect.

All hardware and furniture for doors and windows, together with any exposed electrical installation in walls shall be removed before painting commences. Upon completion of all paintwork all such hardware and furniture etc. shall be re-installed and left in good working order.

Floors shall be covered as protection against staining by paint.

19.2 BLOCKWORK

Surfaces of concrete and rendering to be painted shall first be washed down and then allowed to dry. Any efflorescence present shall be thoroughly removed, and the area so affected shall be given a coat of porous alkali-resistant primer. After any traces of grease have been removed the surfaces shall be painted with two coats of emulsion paint of the copolymer acrylic type. Any cracks in walls shall be cleaned, filled and puttied up then left to dry before application of paint.

Plastered surfaces shall be left as long as possible to dry out before being painted and after any efflorescence has ceased to form and has been removed, they shall be painted with two coats of an approved porous emulsion paint. When a gloss paint finish is called for, this coat or coats should only be applied over the emulsion paint after an interval of at least six months.

19.3 WOODWORK

Woodwork to be painted shall be reasonably dry and its surfaces shall be cleaned and made smooth by the use of fine sand paper obliquely across the grain. The surfaces shall then be dusted off with a dusting brush.

Knots shall be sealed with knotting putty to BS 1336, unless very resinous, when they shall be cut out and the depressions filled after priming. The work shall then be thoroughly primed by brush with a priming paint to BS 5082 and 5358, end grain being given two coats. Cracks, holes and open joints shall be stopped with a mixture of equal parts of hard stopping and linseed oil putty.

Two coats of undercoating of approved manufacture shall be applied, the surfaces being rubbed down between coats. The surfaces on being dry shall then be painted with a final coat of gloss paint leaving no brush traces or irregularities.

Hardwood surfaces shall not be painted but shall instead be treated with two coats of linseed oil, of the clear boiled type. The linseed oil shall be well rubbed in, until the surface of the wood is clearly capable of not absorbing any further linseed oil. The second coat shall be applied between 8 and 12 days after the application of the first coat.

19.4 METALWORK

Galvanised metal surfaces shall first be treated with one coat of mordant solution which shall in due time be carefully washed off. The surface shall then be primed with a calcium plumbate primer. When this has dried thoroughly, the surfaces shall be given one coat of undercoat and one of a gloss finishing paint.

All metalwork shall be cleaned free from all rust, scales, grease, oils and any other surface stains, and shall be given one coat of an approved primer compatible with the metal to be painted, two applications of undercoat and one application of a gloss finishing coat.

The Contractor shall seek specific instructions to paint any non-ferrous metal surface.

All metalwork which has been supplied with bituminous protection or painting prior to despatch from the place of manufacture, such as pipes, tubes, valves, manhole covers, etcetera, shall have all exposed surfaces painted after erection.

The manufacturer’s primer or coating shall be made good to the same standard and specification as supplied, and shall then be given two coats of paint as follows:-

(a) Pipes, valves, manhole covers, and fittings, etc. exposed to view shall be painted with two coats of an approved "bitumastic aluminium paint" or similar approved paint.

(b) Pipes, valves and fittings, etcetera in manholes, or chambers shall be painted with two coats of bitumastic paint or other approved paint.

19.5 STRUCTURAL STEELWORK

All surfaces to be painted shall be dried and cleansed free of all oil, grease, dirt or other extraneous matter by the use of white spirit, water or other appropriate cleaning material. Where surfaces have been damaged in transit they shall be made good to the same standard to which they were originally protected. Where as a result of such damage the metal has been bared, the paint immediately adjacent to the affected area shall be trimmed down, the affected area cleaned by wire brushing and the protective paint system restored, to provide a coat by coat lapping at the junction of the new and old paint systems. Where welding has been carried out on site, the welds shall be deslagged and wire brushed, and a protective paint system applied similar to that of the surrounding steel surfaces.

Where surfaces have been left unpainted and are to be connected by High strength friction grip bolts they shall be cleansed as specified in Specifications Section 20 and the contact surfaces brought together without further treatment. After bolting up, those surfaces which, being exposed are not protected, shall be wire brushed, primed and painted to the requirements of Specifications Section 20 to give a coat by coat lapping with adjoining painted surfaces.

Where surfaces have been left unpainted and are to be completely embedded in concrete they shall be cleaned of all oil, grease milscale or other extraneous matter immediately prior to concreting but shall otherwise be left untreated. Where steelwork is to be partially embedded in concrete the paint system shall be continued into the concrete for a distance equal to the least lateral dimension of the concrete forming the surround.

Unless otherwise specified the final coat of finishing paint Specifications Section 20 shall be applied to the immediate area of all steelwork connections after completion of erection. The main body of the steelwork, however, may be painted on site before erection, in which case any
damage sustained during the course of erection shall be made good to the satisfaction of the Engineer. Painting will not be permitted when the temperature is below 3 C or when Relative Humidity is in excess of 85% or during wet weather.

19.6 GALVANISING

Galvanising shall be hot dip galvanising conforming to the requirements of BS 729. Galvanising shall be applied at the rate of 610 g/m² of surface area in a uniform covering of 100 microns thickness.

19.7 FINISHING OFF

All surfaces including window panes shall be left clean and doors and window hinges lubricated.
20.0 STRUCTURAL STEELWORK

20.1 General requirements

Unless otherwise specified on the drawings or described in the specifications all steelwork shall comply with the requirements of BS 5950: 1990 “The Use of Structural Steel in Buildings” including the current addenda and BS 2853: 1997 “The Design and Testing of Steel Overhead Runway Beams”.

20.2 Drawings

Two copies of all shop drawings by the Contractor shall be submitted to the Engineer for his approval, but this approval shall in no way relieve the Contractor of his responsibility for the work under the Contract and the Contractor shall be fully responsible for ensuring that the details and workmanship result in correct assembly of the work. These drawings shall be submitted to the Engineer in sufficient time for any amendments to be incorporated in the works.

No variations or alterations from the approved shop drawings and this specification shall be permitted without the consent of the Engineer.

20.3 Substitution of materials.

No substitution of materials or section sizes shall be permitted without the express written permission of the Engineer. Notification of any substitutions offered by the Contractor shall be made within 28 days after the Contract.

20.4 Testing laboratory

Testing of materials is to be carried out at the Contractor's expenses at a testing laboratory as approved by the Engineer.

20.5 Inspection

The Contractor shall give the Engineer ample notice of the beginning of the work so that inspection may be provided at the works where steelwork is being fabricated and at all places where materials for the work are being manufactured or from which they are being supplied. No material shall be manufactured or work done in the shop before the Engineer has been notified.

The Contractor shall supply the Engineer with copies of the ordering list of all materials which are obtained from rolling mills and shall also supply test sheets for such materials. List of materials to be obtained from stock with the name of the manufacturers shall be supplied. If test sheets for these materials are not available the Contractor may be required to dispatch sample pieces as directed to an approved laboratory. In this case the Contractor will be required to provide the sample pieces free of charge and pay the carriage to the testing works. The decision of the Engineers as to the acceptance or rejection of the materials in view of reports obtained from the testing works shall be final. The Contractor shall bear the costs of all tests materials and workmanship.

20.6 Structural steel

Unless otherwise stated structural mild steel shall comply in all respects with the requirements of BS 4360 Grade 43A or the equivalent grade in BS 7668- 1994.

Hot rolled Hollow Sections shall comply with the requirements of BS 7668, 43C.

The dimensions of all structural rolled shapes except angles, the form, weight, tolerance etc., shall conform to the requirements of BS 4 “Structural Steel Sections, part 1 Hot rolled Sections”, including current addenda. Angles shall comply with BS EN 10056 “Specification for Structural Steel Equal and Unequal Angles”

Rectangular hollow sections shall conform to the requirements of BS EN 10210 "Hot finished Structural Hollow Sections of non-alloy and fine grain Structural Steels”.

Cold formed Zed purlins shall have a minimum yield stress of 200 N/mm².

20.7 Bolts, nuts and washers

Mild steel black bolts and nuts shall conform to the requirements of BS 4190 "Black Bolts and Nuts". Washers shall comply with the requirements of BS 4320 "Black Washers".

20.8 Electrodes

Electrodes shall conform with the requirements of BS EN 499 "Covered Electrodes for Manual Metal Arc Welding of Non-Alloy and Fine Grain Steels".

20.9 Painting

Primer: All members will be shop painted with one coat of Red Oxide Zinc Chromate primer; applied by brush employing a criss-cross technique of semi-matt finish and suitable to provide a key for subsequent paint coating.

Thinning, if required, shall be done with mineral turpentine up to 5 %.

Method of application, surface preparation, drying time as well as any other requirements shall be done in accordance with the manufacturer’s specification.

Shop painting shall be done after fabrication and within the specified time after the metal surfaces have been cleaned. Any damage to the surface from weather or other exposures should be avoided. Shop contact surfaces shall not be painted unless specified. Unless otherwise specified, surfaces to be in contact only after erection shall be painted except where the paint may interfere with assembly.

Surfaces not to be in contact but which will be inaccessible after assembly shall receive three shop coats of the specified primer before assembly.

The areas of steel surfaces to be in contact with concrete shall not be painted.

Application of the primer shall be by brush employing a criss-cross technique. Paint shall be worked into all crevices and corners and all runs or sags shall be brushed out. There will be a minimum of brush marks left in the applied paints.

FABRICATION

20.10 General

Structural material, either plain or fabricated, shall be stored at the fabrication shop above the ground on platforms, skids or other supports. It shall be kept free from dirt, grease or other foreign matters and shall be protected as far as is practicable from corrosion.

Structural sections before being worked must be straight. If straightening is necessary, it shall be done by methods that will not injure the metal and sharp kinks and bends shall be cause of rejection of the material.

Finished members shall be true to line and free from twists, bends and open joints.

The ends of facing bars shall be neatly rounded unless another form is required.

The bearings shall be accurately machined square with the axis so that the parts connected shall butt over the entire surface of contact.

Slab bases and base plates shall be in one solid piece accurately machined over bearing surfaces and shall be in effective contact over the whole areas. Unless otherwise instructed, a bearing face which is to be otherwise grouted directly to a concrete foundation need not be machined if the bearing surface is true and parallel to the machined upper face.

20.11 Holes and bolted connections

All holes drilled or punched shall be drilled (punched) so that before any reaming is done, a cylindrical pin 3mm in diameter than the nominal size may be entered normal to the surface of the member, without drifting, in at least 75% of the contiguous holes in the same plane. If requirement is not fulfilled, the badly drilled (punched) pieces will be rejected. If any hole will not pass a pin 5mm smaller in diameter than the nominal size of the hole, the steel member having such a hole will be rejected.

When all holes are reamed or drilled, 85% of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1mm between adjacent thicknesses of metal.

The drilling done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. If any hole must be enlarged to admit the metal, it must be reamed.

Holes shall be truly cylindrical. The size of holes shall be 2mm greater than the nominal diameter of
the bolts, unless otherwise specified, and shall be made a driving fit with the bolts. Holes shall be at right angles to the surface of the metal so that both head and nut will bear squarely against the metal. Bolts shall be driven accurately into the holes without damaging the thread.

The heads and nuts shall be drawn tight against the work with a suitable wrench. Bolts heads shall be tapped with a hammer while nuts are being tightened. All bolts shall have threads neatly and accurately finished. If for any reason the bolts twist before drawing tight into the hole shall be carefully reamed and the bolts replaced with a new bolt of diameter to fit properly in the hole.

Nuts shall closely fit the bolts so that they can only just be turned by hand. Bolts shall show two clear threads through the nuts and shall have one washer under the nuts unless otherwise specified. The threaded portions of the bolts shall not bear upon the thickness of the metals connected.

20.12 Flame cutting

The flame cutting procedure shall be carried-out to the satisfaction of the Engineer. The edges resulting from manual flame cutting shall be smoothed with special care. All re-entrant corners shall be filleted to a radius of at least 20mm. The cut lines shall not extend beyond the fillet and all cuttings shall follow closely the lines prescribed. No site flame cutting shall be done without the permission of the Engineer.

20.13 Fitted Stiffeners

Stiffening angles or plates to brackets, flanges, etc., shall be accurately ground to fit the profile of the stiffened member.

20.14 Welding


Surfaces to be welded shall be smooth, uniform and free from fins, tears and other defects which would adversely affect the quality of the weld. Surfaces to be welded shall also be free from loose scale, slag, rust, grease or other material that will prevent proper welding. Mill scale that withstands vigorous wire brushing may remain.

Welds shall not be in excess of those specified by design requirements and shop drawings nor shall their location be changed without approval of the Engineer.

The Contractor shall, before commencement of the fabrication, submit to the Engineer for his approval a list of qualified welders who shall carry out welding operations and shall certify that such welders have been doing satisfactory welding or similar structural work for at least 6 months immediately prior to the subject work. When required by the Engineer, the tests as laid down in the BS 4871 Specification shall be carried out. The test specimens shall be supplied and forwarded free of charge and all testing shall be paid for by the Contractor.

SPECIFICATIONS

If, in the opinion of the Engineer, the microscopic inspection is not sufficient to establish the quality of the fully penetrated butt-welds, the Contractor shall provide for such welds to be inspected by X-ray, ultrasonic or any other method as directed by the Engineer. Any such inspections shall be paid for by the Contractor.

Any weld or member showing defective and sub-standard workmanship shall be rejected.

The parts to be joined by fillet welds shall be brought into as close contact as practicable and in no event shall be separated more than 2mm. If the separation is greater than 2mm the leg of the fillet weld shall be increased by the amount of separation.

The fit of joints which are not sealed by welds throughout their lengths shall be sufficiently close to exclude water after painting.

Abutting parts to be joined by butt-welds shall be carefully aligned. Measurement of fillet weld shall be based upon centre line of parts unless otherwise shown on the drawings. Unless otherwise described, all butt welds shall be fully penetrated butt welds made between fusion faces.

The general welding programme for shop and site welding including particulars of the preparation of fusions faces, the methods of making the welds and the types of electrodes shall be submitted to the Engineer for his approval before commencement of the Work.

Members to be welded shall be brought into correct alignment and held firmly in position by bolps, clamps, struts or by track-welds until welding has been completed. The use of jigs is preferable and adequate allowances shall be made for warpage and shrinkage. Tack-welds that are to be incorporated in the final welds shall be subject to the same quality requirements as the final welds. Such tack-welds shall be as small as practicable and shall be cleaned and fused thoroughly with the final weld.

Defective, cracked and broken tack-welds shall be removed before final welding.

Welding shall be carried out only under the direction and supervision of an experienced, competent and qualified supervisor. Unless otherwise agreed by the Engineer, a record shall be kept to enable major welds to be identified with the welders responsible for the work.

Before welding over previously deposited metal the slag shall be removed and the weld and adjacent base metal shall be brushed clean. This requirement shall apply not only to successive layers but also to successive beads and to the crater area when welding is resumed after any interruption.

All but-welds, except when produced with the aid of backing-plates, shall have the root of the initial weld gouged, chipped or otherwise removed to sound metal before welding is started from the other side. Butt-welds made with the use of backing-plates of the same materials as the base metal shall have the weld metal thoroughly fused with the backing.

Butt-welds shall be extended beyond the edges of the parts to be joined by means of extensions providing a similar joint preparation and having a width not less than 30mm.

Each weld pass shall be terminated at least 20mm from the edge of the parts to be joined. Extensions shall be removed upon completion and cooling of the welds at the ends of the weld shall be made smooth and flush with the edges of the abutting parts.

Neither the depth of fusion nor the total width of fusion at any point in a single weld or weld pass shall exceed the width of the face of the weld or pass.

The welding current, the arc voltage, the speed of travel shall be such that each pass shall have complete fusion to adjacent base metal and weld metal and that there will be no overlap of undue undercutting.

When the welding current, arc, voltage, speed of travel and type of electrode to be used are established by a test, they shall be kept within the following limits of:

- Welding current + or - 10%
- Arc Voltage + or - 7%
- Speed of travel + or - 10%

20.15 Correction in Welding

In lieu of the rejection of an entire piece of member containing welding which is unsatisfactory or indicates inferior workmanship, the Engineer may permit the Contractor to apply the corrective measures, and such approval shall be entirely at the Engineer’s discretion.

20.16 Cambering

Each truss shall be cambered as specified on the drawings. A camber diagram shall be submitted to the Engineer showing the camber at each panel point for each truss taken from actual measurement while the truss is assembled.

20.17 Preparation of surfaces to receive paint

Surfaces of metal to be painted shall be thoroughly cleaned by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances. Any of the following methods may be employed:

- Solvent cleaning (Method A)
- Power tool cleaning (Method B)
- Blast Cleaning to BS 7079 (Method C)
- Hand tool cleaning (Method D)

The blast cleaned surfaces shall be examined for any traces of oil, grease or smudges deposited in the cleaning operation. If present, they shall be removed with white spirit or other solvent.
Cleaned metal surfaces shall be protected within the following periods:

Method A and D – 6 hours
Method B and C – 4 hours

A sample of steel panel measuring not less than 150 x 150 x 6mm, cleaned using any of the specified cleaning methods approved by the Engineer, shall be adequately protected by sealed clean polythene wrapping and submitted to the Engineer for his approval before any work is put in hand. The approved sample shall then be retained by the Engineer’s Inspectors for comparison with the prepared steelwork.

Paint shall not be applied in fog, mist or rain, or when the relative humidity exceeds 75%. Paint shall not be applied to wet or damp surfaces.

No thinner shall be added to the paint unless necessary for proper application.

The type of thinner shall comply with the paint specifications.

When the use of thinner is permissible, thinner shall be added to the paint during the mixing process. Painter shall not add thinner to paint after it has been thinned to the correct consistency.

All thinning shall only be done by the painting supervisor who shall be well acquainted with the paint specification and with the paint application.

Painted steel shall not be handled until the paint has dried-out except for necessary handling in turning for painting or stacking for drying. Paint which is damaged in handling, storing, loading and off-loading, transport and erection shall be scarped off to bare metal with sand paper and touched up with the same kind of paint as was previously applied to the steel, by at least 50mm all round the affected parts.

20.18 Assembly and erection

Prior to erection, the Contractor shall check all levels, alignments and positions of the concrete bases and anchoring holes and bolts. Prior to the despatch of any steelwork to site, advice notes shall be sent to the Engineer.

The Contractor shall provide the falsework and all tools, machinery and appliances necessary for the expeditious handling of the work and shall do all work necessary to complete the structure as required by the Contract and in accordance with the drawings, specification and time schedule.

Anchor bolts, plates, etc. to be built into the foundation shall be fabricated and delivered to site sufficiently in advance of the other steelwork to enable the Contractor to build these items into the works in accordance with the schedule of the works.

Materials to be stored at site shall be placed on skids above the ground and shall be kept clean. Long members shall be supported on skids placed near the available stock lengths of roof sheeting. However, the Engineers approval must be obtained before alteration is made in purlin spacing or sheeting sizes.

Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled.

The straightening of plates and angles or other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted by the Engineer, in which case the heating shall not be to a higher temperature than that producing a “dark cherry red” colour. After heating, the metal shall be cooled as slowly as possible and the surface of the metal shall be carefully inspected for evidence of fracture.

Before starting the work of erection, the Contractor shall inform the Engineer fully as to the method of erection he proposes to use which shall all be subject to the approval of the Engineer. Such approval shall not be considered as relieving the Contractor of the responsibility for the works in full in accordance with the drawings, specification and time schedule.

The contractor shall agree with the Engineer the sequence of assembly and erection of the steelwork in order that this may conform with the programme of other constructural operations. No work shall be done until such approval by the Engineer has been obtained.

Bolted site joints shall not be finally tightened until the structure is properly plumbed, levelled and aligned. No straining into position, after bolts have been finally tightened shall be allowed.

Immediately after final tightening of all bolted connections, all anchor holes and column bases shall be grouted to the satisfaction of the Engineer.

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

Field connections shall be as detailed i.e. bolted with high tensile or black bolts in drilled holes. Black bolts on punched holes will only be permitted for connections carrying a designed load or for connection to timber members. Trusses shall be carefully set out to the dimensions shown on the drawings. Where it is required that the trusses be cambered, such camber shall be provided by bending the bottom chord to the arc of a circle.

Not withstanding any dimensions spacing of purlin cleats, the sub-contractor shall ensure that the purlin cleat spacing is satisfactory for
where shown on the details.

20.19 Zed purlins and Zed Rails

Where any row of zed purlins are provided with diagonal tie bars, the purlins between which the tie bars are located together with the sag rods shall be erected first, ensuring that good level line is achieved. Remaining purlins and sag bars shall then be erected, and adjusted to the correct alignment from the previously aligned purlins.

Where any row of zed purlins are provided with diagonal tie bars, the rails incorporating the tie bar and rail support angle(s) shall be erected first, ensuring that a good level line is achieved. Remaining rails and rail supports shall then be erected and adjusted to the correct alignment from the previously aligned rails.

Pressed or cold rolled steel purlins and girts shall be to the sizes indicated on the drawings and shall be formed from approved steel strip with a minimum yield strength of 185N/mm². The sections shall be manufactured straight and free from twist, the tolerance away from straightness shall not be greater than 2mm for every 1.50m in length along any folded edge.

20.20 Holding down bolts

Holding down bolts shall be set in sleeves of steel tubes or similar approved and provided with steel washer plate cast in the concrete and standard nut and washer.

20.21 Special prime painting

All steelwork where indicated on the drawings shall be shop primed with one coat Epoxy Coal Tar Paint which dries by chemical curing. The paint shall be applied in accordance with the manufacturers instructions.
21.1 General

All masonry work shall be constructed from building stone as specified in Part 4 or approved concrete blockwork as specified in Part 4.

For culvert headwalls and other small works, the stone shall, unless otherwise specified, be rough dressed. For walls, facing and other exposed works the stone shall, unless otherwise specified, be medium chisel-dressed.

21.2 Workmanship

All masonry work is to be constructed in compliance with BS 5.

The Contractor shall provide and use proper setting-out rods for all work.

Stones and blocks shall be well soaked before use and the tops of walls shall be kept wet as the work proceeds. The stones and blocks shall be properly bonded so that no vertical joint in a course is within 115mm of a joint in the previous course. Alternate courses of walling at angles and intersections shall be carried through the full thickness of the adjoining walls. All perpends, reveals and other angles of the walling shall be built strictly true and square.

The stones and blocks shall be bedded, jointed and pointed in mortar (1:3) in accordance with Part 4, with beds and joints 9mm thick flushed up and grouted solid as the work proceeds.

All work shall be cured in accordance with the relevant requirements of Part 4.
PART 22 MATERIALS

22.1 Standard Specification

In cases 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.

The latest version of the standards referred to under this Section shall be used where applicable.

22.2 Submission of Samples

As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer 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 Engineer, or his representative, to his premises during ordinary working hours for the purpose of obtaining samples of the materials in question. Alternatively, if desired by the Engineer, the Contractor shall deliver the samples of the materials to the Engineer’s office, without charge. 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 not source of supply shall be changed without the Engineer’s prior approval.

Samples of materials approved will be retained at the Engineer’s office until the completion of the Contract. Samples may be tested to destruction.

All materials delivered to Site must be at least equal in all respects to approved samples.

22.3 Cement

Ordinary Portland Cement and rapid-hardening Portland cement shall comply with the relevant section of the “Concrete Specification” or other standards as given in Concrete Specification.

 sulphate resisting cement shall comply with the physical requirements of British Standard 12: Portland Cement (Ordinary and Rapid-hardening).

High alumina cement shall comply with the requirements of British Standard 915: High Alumina Cement.

White or coloured cement shall be of approved quality and chemical composition, and shall comply with the physical requirements of British Standard 12: Portland Cement (Ordinary and Rapid-hardening).

Cement shall be delivered in broken bags, barrels or by an approved bulk delivery vehicle.

Cement shall be stored in a dry weatherproof shed with a raised wooden floor, or in a silo, and shall be delivered in quantities sufficient to ensure that there is no suspension or interruption of the work of concreting at any time and if in sheds, each consignment shall be kept separate and distinct. Any cement which shall have become injuriously affected by damp or other causes shall at once be removed from the Site. Cement should be used in rotation.

The Contractor shall furnish as directed by the Engineer test certificates relating to the cement to be used on the work. Each certificate shall indicate that the sample has been tested and analysed by an approved laboratory and that it complies in all respects with the requirements of the appropriate Specification for the particular type of cement.

22.4 Aggregates for Concrete

Aggregates for concrete shall consist of naturally occurring material complying with the requirements of British Standard 1200: Concrete Aggregates from Natural Resources.

A certificate as to compliance with the British Standard shall be provided by the supplier to the aggregate. Tests for the determination of impurities in the sand shall be made once daily, until the Engineer is satisfied that the specified compressive strength is being regularly obtained, when, with his approval, such tests shall be made once weekly and at other times as directed by the Engineer.

The coarse aggregate, unless otherwise authorised by the Engineer, shall be delivered to the Site in separate sizes (two sizes when the maximum size is 20mm and three sizes when the maximum size is 38mm or more).

The Flakiness Index when determined by the sieve method described in British Standard 812 shall not exceed 20 for 65mm and 38mm aggregates nor shall it exceed 35 for 20mm and 10mm aggregates.

All aggregates brought upon the Site shall be kept free from contact with deleterious matter and in the case of aggregates passing a 5mm sieve they shall have been deposited in the site of mixing for not less than 16 hours before further use; aggregates of different sizes shall be stored in different hoppers, or different stacks on a clean hard surface and shall be separated from each other as approved by the Engineer.

22.5 Sand for Mortar

a) Sand for mortar shall be natural or crushed stone sand and shall be in accordance with BS 1198-1200 where applicable to sands for general purpose mortars.

b) The source of the sand is to be approved by the Engineer.

c) At the Works the sand is to be stored on a clean, hard surface.

All building stone shall be capable of withstanding when wet a crushing stress of 10N/mm². The source of stone shall be approved by the Engineer and stone supplied therefrom 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 one face and one end, if in other respects it conforms to this Specification. Stones shorter than 375mm will not be accepted.

Unless the Engineer allows otherwise the Contractor shall at his own expense provide and dress four 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with BS 1438: Media for Biological Percolating Filters, Appendix B, (Sodium Sulphate Soundness test) except that:

i) The treatment shall be repeated for 10 cycles only; and

ii) The second criterion of failure shall be amended to allow for a loss weight of not more than 20% of its original weight.

22.7 Stone Dust
22.8 Murram

Murram shall be from an approved source quarried so as to exclude vegetable matter, loam, topsoil or clay. The California Bearing Ratio of the murram, as determined for a sample compacted to maximum density (as defined under Bs 1377) and allow to soak in water for four days, shall not be less than 30. This CBR is a guide to quality only and the compaction in the work will be judged by density.

22.9 Water for Cement Treated Materials

If water for the Works is not available from the Public Mains the Engineer’s approval must be obtained regarding the source of supply and manner of its use. Water to be used with cement or lime shall be free from salt, oil, alkali, organic matter and other deleterious substances. If the water is required to be tested, this shall be done in accordance with the requirements of British Standard 3148 : Tests for Water for Making Concrete.

22.10 Cement Mortar

Cement mortar shall consist of proportions by volume as specified of Portland cement and natural sand or crushed natural stone of a combination of both as specified in British Standard 1188-1200 : Building Sands from Natural Sources. The constituent materials shall be accurately gauged and mixed in an approved manner.

Cement mortar shall be made in small quantities only as and when required, and any mortar which has begun to set or which has been mixed for a period of more than one hour shall be rejected.

22.11 Hydrated Lime

Hydrated Lime shall comply with British Standard 890 : Building Lime, and shall be Class B of the semi-hydrated type.

22.12 Calcium Chloride

Calcium Chloride shall be of a good industrial grade, and shall be obtained from an approved source.

22.13 Lime Mortar

Lime mortar shall consist of proportions by volume as specified of hydrated lime and natural sand or crushed natural stone or a combination of both as specified for cement mortar in clause 14.10. The constituent materials shall be accurately gauged and mixed in an approved manner.

22.14 Cement-Lime Mortar

Cement-lime mortar shall consist of Portland cement, hydrated lime and natural sand or crushed natural stone or a combination of both, as specified for cement mortar in Section 3 of this Specification. The constituent materials shall be accurately gauged and mixed by volume in an approved manner in the proportions specified.

Cement-lime mortar shall be made only in small quantities as and when required and any mortar which has begun to set or which has been mixed for a period of more than two hours shall be rejected.

22.15 Cement Grout

Cement grout shall consist of Portland cement and water mixed in the proportion of one part by volume of cement and one-and- a-half parts by volume of water. The grout shall be used within one hour of mixing.

22.16 Concrete Building Blocks

Precast concrete building blocks shall be in accordance with BS 2028 for Type A blocks from an approved source.

The faces of the blocks shall be smooth, true to shape with sharp arrises and be free from pitting and other surface defects.

22.17 Building Stone

Stone used for building shall be the best quality hard local stone obtained from approved quarries and shall be sound throughout so as to ring when struck and shall be free from all defects. Stones shall be dressed into true rectangular blocks with each surface even and at right angles to all adjoining surfaces and equal to samples submitted to and approved by the Engineer.

22.18 Steel Reinforcement

Mild steel and hot-rolled high tensile steel rod reinforcement for concrete shall be as specified in British Standards 4449, 4482 : Rolled Steel Bars and Hard Drawn Wire for Concrete Reinforcements. Cold-twisted high tensile bars shall be as specified in British Standard 4461 Metric Units : Cold-twisted Steel Bars for Concrete Reinforcement. Steel fabric reinforcement shall be as specified in British Standard 4483 : Steel Fabric for Concrete Reinforcement, and shall be delivered to the Site in mats, unless the Engineer agrees otherwise, and free from any permanent set tending to make it curl under vibration.

The Contractor shall furnish the Engineer with copies of the manufacturer’s certificates of test for the steel reinforcement to be supplied. The Engineer, may however, order independent tests to be made and any steel which does not comply in all respects with the appropriate foregoing Specifications will be rejected.

22.19 Granular Material for Pipe Beddings

Granular material for pipe beddings shall consist of well and evenly graded material such as gravel or broken stone, having a grading of 19mm to 5mm, free from fines, readily compactible and free draining.

The grading of supplies will be frequently checked.

22.20 Concrete Pipes and Specials

Concrete pipes and specials shall comply with the requirements of British Standards 5591. They shall carry the British Standards Institution registration certificate trade mark, or test certificates shall be furnished by the manufacturers.

22.21 Concrete Porous Pipes

Concrete porous pipes shall comply with the requirements of British Standard 5911: Concrete porous Pipes for Under-drainage.

22.22 Concrete Drain Invert Blocks

Precast concrete invert blocks shall be 150 mm dia. Half round manufactured to the detail Drawings supplied from concrete of the appropriate Class specified in Section 3 of this Specification using maximum 12mm size aggregate. If required, cube test certificates shall be supplied by the manufacturer.

22.23 Concrete Slabs for Open Drains

Precast concrete slabs for lining open drains shall be manufactured to the detail Drawings supplied from concrete of the appropriate Class as specified in Tables 14.2, 14.3 and 14.4 using maximum 12mm size aggregate. If required, cube test certificates shall be supplied by the manufacturers.

22.24 Drainage Ditch Warning Posts

SPECIFICATIONS

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Preceding concrete drainage ditch warning posts shall be manufactured to the detail drawings from concrete of the appropriate class specified in Section 3 of this Specification. If required, cube test certificates shall be supplied by the manufacturers.

22.25 Agricultural Tiles and Pipes

Agricultural tiles and pipes shall be best well burnt earthenware, true and circular in bore and with an externally flat bottom and plain ends suitable for laying with open or butt joints.

22.26 Manhole Covers and Frames

Manhole covers and frames shall be basically in accordance with the requirements of BS EN 124: Cast Manhole Covers, Road Gully Gratings and Frames for Drainage Purposes, except that manhole covers shall be constructed of mild steel, concrete filled, and set in grease/bitumen for water tightness in accordance with the Local Authority's standard detail drawings.

Foulwater sewer manholes shall have triangular Grade ‘A’ heavy duty covers and frames. Circular manhole covers and frames shall be used on surface water sewer manholes, and also heavy duty covers where indicated on the drawings.

22.27 Gully Gratings and Frames

Gully gratings and frames shall be basically in accordance with the requirements of BS EN 124 497, nominal size 500mm x 350mm, except that the gully gratings shall be constructed of mild steel, concrete filled in accordance with the Local Authority’s standard detail drawings.

22.28 Precast Concrete Manholes and Inspection Chambers

Preceding concrete manholes and inspection chambers shall comply with the requirements of British Standard 5911: Concrete Cylindrical Pipes and Fittings including Manholes, Inspection Chambers and Street Gullies, and they carry the British Standard Institution registered certification trade mark, or test certificates shall be furnished by the manufacturers.

22.29 Precast Concrete Gullies

Preceding concrete gullies shall be unreinforced and shall comply with the requirements of British Standard 5911: Concrete Cylindrical Pipes and Fittings including Manholes, Inspection Chambers and Street Gullies.

22.30 Manhole Step-Irons

Step-irons of general-purpose type shall comply in all respects with BS 1247: Malleable Step Irons.

22.31 Timber

Timber shall be sound, well seasoned and entirely free from worm, beetle, warps, shakes, splits, and all forms of rot and deadwood. Where required, all timber shall be treated with creosote, as specified in British Standard 144: Coal Tar Creosote for the Preservation of Timber, or an alternative approved timber preservative.

22.32 PVC Pipes

uPVC pipes for potable water supply shall comply with BS 3505 and shall be of the type and class as specified in the Drawings or the Bills of Quantities. Where uPVC pipes are to be used for gravity sewerage, they shall be to BS 5481 for sizes DN200 and above and to BS 4660 for under sizes. Laying, jointing and testing shall be to BS 5955. The joint shall employ a flexible rubber ring which shall meet the requirements of BS 2494. Laying, jointing and testing shall generally be carried out according to the relevant Clauses of this Specification and all as per the manufacturer’s instructions.

22.33 Bitumen

Bitumen shall unless otherwise stated be commercial straight run of penetration 85 - 100 as specified in Table IV - I of the Asphalt Handbook of the Asphalt Institute (USA).

22.34 Cut-Back Bitumen

Cut-back bitumen shall be of the specified grade stated in Tables IV - 2 to IV - 4 of the Asphalt Handbook of the Asphalt Institute (USA).

22.35 Bitumen Emulsion

Bitumen emulsion shall conform to the requirements of British Standard 434: Bitumen Road Emulsion.

22.36 Aggregates for Surface Dressing

Aggregates for surface dressing shall consist of hard, rough, clean crushed rock (blacktrap) as approved by the Engineer. It shall be of approved nominal size and quality and otherwise in conformity with the requirements of British Standard 63: Single Sized Road Stone and Chippings.

22.37 Dry Rubble Backing

Dry rubble backing shall consist of broken stone of approved quality, graded from 100mm to 50mm.

22.38 Precast Concrete Kerbs, Channels, Edgings and Quadrants

Unless otherwise stated in the Bills of Quantities precast concrete kerbs, channels, and edgings shall comply with the requirements of British Standard 7263: Precast Concrete Kerbs, Channels, Edgings and Quadrants. The date of manufacture shall be marked on each unit. If required, test certificates shall be furnished by the manufacturers.

22.39 Precast Concrete Flags

Precast concrete flags/paving slabs shall comply with British Standard 7263: Precast concrete paving slabs shall be 600 x 600 x 50 mm thick, laid on a 50 mm thick sand bed. If required, test certificates shall be furnished by the manufacturers.

22.40 Paint

All priming, undercoating and finishing paints shall be in accordance with British Standard 2521/4: Ready Mixed Oil-based Priming Paints, or British Standard 2525/32 : Ready Mixed Oil-based Undercoating and Finishing Paints (Exterior Quality), as appropriate.
PART 23 TESTING OF MATERIALS AND WORKMANSHIP

23.1 Apparatus Required for Testing on Site

Apparatus for Testing shall be provided by the Contractor, delivered to the Engineer on Site of the Works, kept in good repair throughout the Contract, and regarded as constructional plant. The following may be required:

a) A set of sieves complying with British Standard 410: Test Sieves, of the following nominal sizes:
   - Fine mesh wire cloth 200, 100, 72, 52, 36, 25, 18, 14, 10, 7.
   - Medium mesh wire cloth 200, 100, 72, 52, 36, 25, 18, 14, 10, 7.
   - Perforated plate 5mm, 6mm, 9mm, 12mm, 20mm, 38mm, 50mm, 65mm, 75mm.
   - Medium mesh wire cloth 3mm
   - A 200ml graduated cylinder in accordance with British Standard 604: Graduated Measuring Cylinders, for use in the field settling test for clay and fine silt in aggregates.
   - Two 0.34kg graduated clear glass medicine bottles for use in the test for organic impurities in sand.
   - Apparatus required for testing soils in accordance with British Standard 1377: Methods of Test for Soil Classification and Compaction, and British Standard 1924: Methods of Test for Stabilised Soils.
   - Apparatus for testing concrete in accordance with British Standard 1881: Methods of Testing Concrete, Parts 1 to 7.
   - A straight edge 3 metres long and measuring wedge or other approved apparatus for testing the accuracy of surfaces in accordance with Clause 23.4.
   - Additional testing equipment as stated in the Bills of Quantities.

23.2 Testing of soil

During the progress of earthworks the Contractor shall provide facilities for, and all assistance required by, the Engineer in carrying out tests, taking samples of the soil and packing these into containers. When required the Contractor shall then send them to an approved laboratory for testing.

23.3 The Slump test

This test is to be used during the progress of the work in order to give an indication of the consistency of the concrete. The consistency shall be recorded in terms of inches of subsidence of the specimen during the test, which shall be known as the slump. The respective slumps to be used for various portions of the structure shall be regulated in accordance with the instructions of the Engineer.

The test specimen shall be formed in a mould in the form of the frustum of a cone having the following internal dimensions: bottom diameter 200mm, top diameter 100mm, and height 300mm. The mould shall be constructed of metal of at least 1.5mm thickness and the top and bottom shall be open and at right angles to the axis of the cone. The mould shall have a smooth internal surface and shall be provided with suitable foot pieces and handles; and tamping rod shall be of steel 15mm diameter and 600mm long and rounded at one end.

The internal surface of the mould shall be thoroughly clean free from superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth, horizontal, rigid and non-absorbent surface, such as carefully levelled metal plate, the mould being firmly held in place while it is being filled.

The mould shall be filled in four layers, each approximately one quarter of the height of the mould. Each layer shall be tamped with 25 strokes of the rounded end of the tamping rod. The strikes shall be distributed in a uniform manner over the cross-section of the mould and for the second and subsequent layer shall penetrate into the underlying layer. The bottom layer shall be tamped through its depth. After the top layer has been rodded, the concrete shall be struck off level with a trowel or the tamping rod, so that the mould is exactly filled. Any mortar which may have leaked out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This will allow the concrete to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested. The above operations shall be carried out at a place free from vibration or shock and within a period of two minutes after sampling. The slump measured shall be recorded to the nearest 6 millimetres.

Any slump specimen which collapses or shears off laterally will give an incorrect result and if this occurs the test shall be repeated with another sample. If, in the repeat test, the specimen should shear the slump shall be measured and the fact that the specimen sheared shall be recorded.

23.4 Measurement of Surface Irregularity

The measurement of longitudinal surface irregularity shall be undertaken using a device comprising a straight edge 3 metres long, and a wedge marked to indicate the limiting tolerances. The device shall operate on a principle indicated in Fig. 15.1. No objection would be raised to other designs embodying the same principle of measurement.

Irregularity shall be measured with the wedge indicated in Fig. 23.1 moved transversely at various points until it touches both the straight edge and the surface.

The permitted tolerances are summarised in Table 14.5 of clause 14.5.

23.5 The Cube Test

The method described applies to compression tests of concrete sampled during the progress of the Works. The standard size of specimens shall be 150mm cubes.

The moulds shall be of metal with inner faces accurately machined in order that the opposite sides of the specimens shall be plane and parallel. The mould shall be so constructed in such a manner as to facilitate the removal of the moulded specimen without damage. Each mould shall be provided with a metal base plate having a plane surface. The base plate shall be of such dimensions as to support the mould during the filling without leakage and it should be attached to the mould by springs or screws. The interior surface of the mould and the base-plate shall be thinly coated with mould oil before the concrete is placed in the mould.

The lifting bar shall be a steel bar weighing 1.8 kg. and 375mm long and shall have a ramming face 25mm square.

The sample of freshly mixed concrete shall be obtained by the method specified.

Cubes shall be clearly and indelibly marked for identification and records shall be kept of date...
SPECIFICATIONS TESTING OF MATERIALS AND WORKMANSHIP

of casting, mix, portion of structure and all other relevant details as required by the Engineer, and shall be delivered to the testing laboratory damp, well protected and in good condition.

The cubes shall be crushed by a Testing Laboratory approved by the Engineer and in accordance with BS 881. Provided that care is taken to ensure that no water is lost the material used for the slump tests may be re-mixed with the remainder of the mix before making the test cubes.

The concrete shall be filled into the mould in layers approximately 50mm deep and each layer shall be compacted with the tamping bar. For mixes of 38mm slump or less 35 strokes of the bar shall be given for each layer; for mixes of wetter consistency the number may be reduced to 25 strokes per layer. The cubes shall not be compacted by means of vibration.

The cubes shall be stored on the Site in a place free from vibrations at a temperature between 5ºc and 25ºc, and under damp or wet conditions until required for testing.

23.6 Correction for Age of the Strengths of Concrete Cubes or Cores

Correction for the age of cubes and cores made with normal Portland cement shall be made by taking the appropriate figure given in Table 1 to give the corresponding strength at 28 days.

Table 23.1

<table>
<thead>
<tr>
<th>Age in Weeks</th>
<th>Correction to be Deducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
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<tr>
<td>6</td>
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<tr>
<td>12</td>
<td>0.74</td>
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<tr>
<td>13</td>
<td>0.81</td>
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</tbody>
</table>
PART 24 GENERAL
SPECIFICATION
FOR PLUMBING AND DRAINAGE
SERVICES

24.1 MATERIALS AND
WORKMANSHIP

GENERAL

All materials shall be new and in accordance with the types and manufacture described herein and shown on the Contract Drawings. The Contractor shall not vary the materials stated without written approval of the Engineer.

The installations shall comply with all relevant statutory instruments and regulations current at the date of tender (unless stated otherwise in this specification or any drawing) and in particular with the following:-

1. The Institution of Electrical Engineers (IEE) Regulations for the Electrical Equipment of Buildings.
2. Requirements as stated by the Chartered Institute of Building Services Engineers.
5. Local Safety Regulations.
6. Any special requirements of the local Authorities.

The equipment and installations shall comply with all other relevant British Standards and Codes of Practice. In the event of a discrepancy between this specification and any BS or BS 8301:1985 the Contractor shall notify the Engineer and wait for his ruling.

STORAGE OF EQUIPMENT

All stored items shall be maintained under a weatherproof and shady cover until ready for incorporating in the works. All equipment and materials shall be protected against corrosion and damage. Any equipment damaged, whether before, during or after installation shall be replaced with new equipment at the Contractor’s cost.

Tubes shall be delivered, stored and maintained in storage with any open ends efficiently plugged capped or sealed.

All fittings valves and sundry items shall be stored in clean bins or bagged and stowed in suitable racks.

Care must be taken to protect all P.V.C., MDPE or plastic type pipework and fittings from continuous sun rays. Pipe should be supported in suitable racks as indicated by the manufacturers to prevent distortion and over loading.

NEW COMPONENTS

All components shall be new and the Contractor may be required to produce certified invoices to verify this.

PAINTING AND PROTECTION

All materials and equipment shall be adequately protected against corrosion and damage in transit before leaving the manufacturers works.

WORKMANSHIP

All work shall be carried out in keeping with good engineering practice. The Contractor shall ensure that the work is carried out by competent employees who are skilled and experienced in the class of works involved.

24.2. PIPEWORK

PIPEWORK GENERALLY

All pipework shall be cut square made free from burrs and shall be thoroughly cleaned before erection. Open ends left during the erection of the pipework shall be sealed with proper plugs or caps. Rags and paper plugs will not be allowed.

The pipework shall follow the lines of walls and a gap of at least 30mm shall be maintained between pipes (or their lagging) and the wall. Particular care shall be taken that all pipework is erected and secured truly parallel with vertical surfaces and any adjacent services and that all vertical drops are plumb. To allow venting and draining down of the pipework, where possible horizontal pipes shall be fixed to a fall.

Joints will not be permitted within the thickness of any wall, floor or ceiling. Where pipes penetrate walls, floors or ceilings, they shall be accommodated in suitable pipe sleeves of the same material for the full thickness of the wall, floor and wall plates shall be used where visible. Where the pipework is insulated, the sleeve shall be of sufficient size to accommodate the full thickness of insulation.

Connections between differing materials shall be detailed and submitted for approval, before work is commenced.

All pipework passing through floors and firewalls shall be caulked with an Intumescent caulking compound except where approved proprietary fire sleeves are used.

Access

Access to stacks and services should readily be available in particular where access points to stacks and service valves occur.

All pipes, water services and overflows shall be banded or labelled indicating the type of service in accordance with BS 1710. In addition flow direction arrows shall be provided.

SOIL AND WASTE PIPEWORK

Pipework in this section of the specification shall comply with BS 5255 for plastic wastepipes and fittings, and BS 4514 for uPVC soil and ventilation pipes and fittings, and BS 3868 for galvanised mild steel tube.

Jointing of mild steel soil and waste pipework shall be executed with either the caelfit joint to BS 2494 or mechanical joint to BS 3868.

Jointing of uPVC soil and waste pipework shall be executed incorporating either solvent cement jointing techniques or ringseal methods. The solvent cement jointing technique is the preferred method of jointing, but either system will be acceptable. The manufacturer’s pipe jointing recommendations shall be fully complied with. Small diameter (>54mm dia) waste pipework shall not be solvent weld jointed.

The above ground soil and waste system of pipework shall be adequately supported in accordance with the manufacturers instructions. Additional support shall be provided at bends and junctions. Vertical pipework shall be fixed straight and plumb.

Discharge pipes shall be laid to falls as recommended in BS 5572, adequate provision for expansion shall be made.

Access fittings shall be provided in the locations indicated to ensure that all lengths of discharge pipework are accessible for maintenance purposes.

Every care shall be taken to protect the work and to prevent the entry of foreign matter into any part of the system during
construction. Openings shall be sealed with purpose made plugs of metal, plastic or wood.

Special care shall be taken with pipe systems having flexible joints to prevent deflection of the joint after the pipework is assembled. Pipework shall not be allowed to carry any external load either during or after construction.

All access covers and cleaning eyes shall be fitted at the time of installation and be finally fixed and sealed after testing.

**HOT & COLD WATER PIPEWORK**

Hot and cold water pipework shall be installed as called for in the particular specification.

**Copper Pipework**

(i) Pipework, straight runs and or lengths incorporating bends or sets shall be in copper to BS 2871, Part 1, Table x.

(ii) All fittings shall be of DZR bronze or copper to BS 864, Part 2. Joints to Capillary fittings shall only be made with lead free solder.

(iii) Copper pipework and fittings shall be as manufactured by IMF Yorkshire Ltd., P.O. Box 166, Leeds LSI 1RD, England.

**Jointing of Pipework and Fittings**

Jointing of pipework and fittings shall be as follows:

(i) Necessary connections or couplings that are used for joining pipework or fittings of differing materials shall be gunmetal to retard any electrolytic action.

(ii) Any threads of fittings for male/female connections, etc., shall be made watertight with non-toxic PTFE tape or hemp and jointing compound such as "Boss White". All jointing materials should be of the non-toxic type suitable for potable water systems.

(iii) Flux used for soldering copper pipework with fittings shall be of the non-toxic water soluble type for potable water.

(iv) All jointing materials shall be approved by the Local Authority.

(v) 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.

(vi) Short copper connecting tubes between galvanised pipework and sanitary fittings shall not be used because of the risk of galvanic action.

(vii) If, as may occur in certain circumstances, it is not possible to make the connections in any other way than by the use of cooper tubing, then a p.v.c. connector shall be positioned between the galvanised pipe and the copper tube in order to prevent direct contact.

**Galvanised Pipework**

(i) Galvanised steel pipework shall be manufactured to comply in all respects with the standards described for mild steel in accordance with BS 1387.

Galvanising shall be carried out in accordance with the requirements of BS 1398 and BS 143 respectively.

**Jointing of Pipework**

Jointing of galvanised pipe shall be by means of threaded joints sealed with PTFE tape or hemp and jointing compound such as "Boss White". All jointing materials should be of the non-toxic type suitable for potable water systems.

All threads shall be cut full depth and all burrs removed before assembly. Threads shall be fully seated into the fitting.

Unions shall be fitted as necessary to allow dismantling of the pipework. At least one union shall be provided in each run of pipework. Unions must be fitted each side of all fixed equipment to allow removal of the equipment if necessary.

All damage to galvanising due to use of pipe wrenches shall be made good by applying one coat of zinc rich paint such as "Galvafoild" to the damaged area.

**PVC Pipework**

(i) PVC pipework and fittings shall be manufactured to BS 3505 1968 Imperial sizes or ISO 727 Metric Sizes.

All threads shall be to BS 21 or ISO 7. Pressure rating shall be Class D or PN10 unless otherwise stated in the particular specification or on the drawings.

(ii) Jointing

Jointing shall be carried out using Solvent Cement conforming to BS 4346 Part 3 and in accordance with the pipe manufacturers recommendations.

All pipe end shall be cleaned using the manufacturers recommended cleaning agent before applying solvent cement.

All screw joints shall be made using PTFE tape.

(iii) Expansion loops shall be allowed for in all long runs in accordance with the manufacturers recommendations.

**PIPWORK SUPPORTS (ALL SERVICES)**

Pipe hangers shall be generally as described in this specification but the Sub-Contractor shall prepare and submit for approval details of all hangers, supports and accessories before installation, as requested by the Engineer. The Sub-Contractor may use as a substitute for the following described hangers and supports, a proprietary system of pipe supports and brackets provided that full details and drawings are submitted to the Engineer prior to the installation being carried out.

Generally, all supports, brackets, anchors and fixing accessories shall be provided by the Sub-Contractor. For items which are required to be attached to the surface of the building fabric, the Sub-Contractor shall provide competent labour and suitable equipment for drilling and securing the support or fixing accessory.

Acceptance of such work shall be given by the Engineer prior to its commencement. Where individual fixings require the cutting of and building into the building structure, the Sub-Contractor shall arrange and shall provide all other labour required to ensure that such fixings are located and set to his requirements.

Copper tubing shall be carried exclusively from support members constructed from copper or copper alloy. UPVC piping shall be carried from steel, copper or copper alloy supporting members having plastic liners. Mild steel piping shall have steel supporting members actually in contact with the pipe.

Pipes shall be supported on either side of changes of direction and pipeline mounted equipment, at centres not exceeding the following:-

**Copper Pipes (Table X)**

<table>
<thead>
<tr>
<th>Pipe Diameter (mm)</th>
<th>Horizontal Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>(OD)</td>
<td>(ID)</td>
</tr>
<tr>
<td>15</td>
<td>1200</td>
</tr>
<tr>
<td>22</td>
<td>1500</td>
</tr>
<tr>
<td>28</td>
<td>1800</td>
</tr>
<tr>
<td>35</td>
<td>2100</td>
</tr>
<tr>
<td>42</td>
<td>2400</td>
</tr>
<tr>
<td>54</td>
<td>2700</td>
</tr>
</tbody>
</table>
the final finished paintwork, by the Sub-Contractor.

PIPEWORK SLEEVES

Where pipework for hot and cold services pass through walls and floors they shall be sleeved as follows:-

(i) All sleeves shall be a minimum of two diameters larger than the service pipe. Sleeves shall be of the same material as the service pipework they are installed for.

(ii) Where sleeves are installed in walls they shall be of such length as required for the total wall thickness and finishes. Where exposed the sleeves shall be covered with a chrome plated face plate.

Where sleeves pass through floors they shall be 50mm greater than the total depth of the floor. The 50mm shall project above the floor for water proofing and finishes.

VALVES AND METERS

(a) Draw-off Taps and Stop Valves (up to 50mm 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 BS 1010.

(b) 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 BS 5163. All gate valves required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of BS 1218.

All gate valves up to and including 65mm nominal bore shall be of bronze construction DZR PN16 in accordance with the requirements of BS 5154. The pressure classification of all gate valves shall depend upon the pressure conditions pertaining to the Site of Works.

(c) Check or Non-Return Valves

All check or non-return valves up to and including 65mm nominal bore shall be of the swing check type of bronze construction in accordance with BS 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 BS 5153.

The pressure classification of all check non-return valves shall depend on the pressure conditions pertaining to Site of the Works.

(d) Ball Valves

All ball valves for use in connection with hot and cold water services shall be of the "Underhay" pattern equilibrium type with copper ball complying to BS 1212, constructed from bronze or other corrosion resistant materials. These valves fall into three pressure classifications as follows:-

i) Low Pressure - 3.588 b maximum

ii) Medium Pressure - 7.725 b maximum

iii) 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 the particular specification.

(e) 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 BS 1415 from bronze or other corrosion resistant materials.

(f) Potable water meters shall be to BS 5728.

EXPANSION JOINTS AND ANCHORS

Where practicable, cold pipework systems shall be arranged with sufficient bends and changes of 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 movement do not break the pipe joints.

Where piping anchors are supplied, they shall be fixed to the main structure only. Details of all anchor design proposals shall be submitted to the Architect or Engineer 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.

**INSTALLATION**

**GENERAL**

Installation of all pipework, valves, fittings and equipment shall be carried out under adequate supervision from skilled staff to the relevant codes and standards as specified herein. The Sub-Contractor shall be responsible to the Engineer for ensuring that all builder's work associated with his piping installation is carried out in a satisfactory manner to the approval of the Services Engineer.

**ABOVE GROUND INSTALLATION**

(a) **Water Services**

Before any joint is made, the pipes shall be hung in their supports and adjusted to ensure that the joining faces are parallel and any falls which shall be required are achieved without springing the pipe.

Where falls are not shown on the Contract Drawings or stated elsewhere in the Specification, pipework shall be installed parallel to the lines of the buildings and as close to the walls, ceilings, columns, etc., as it practicable.

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 or in such a position as to be difficult to reach from a short step ladder, extension spindles with floor or wall pedestals shall be provided.

Screwed piping, shall be installed with a 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 pipework, precautions being taken to ensure that any forces produced by pipe movements not transmitted to valves, equipment or plant.

All screw joints to piping and fittings shall be made with P.T.F.E Tape.

All hot water pipework shall be insulated with preformed fibre glass lagging to a thickness of 25mm where the pipe runs above a false ceiling or in areas where the ambient temperature is higher than normal with the result that pipe "sweating" due to condensation will cause nuisance.

All lagged pipes which run in a visible position after erections shall be given a canvas cover and prepared for painting as follows:-

(i) Apply a coating of a suitable filler until the canvas weave disappears and allow to dry.

(ii) Apply two undercoats of an approved paint and finish in suitable gloss enamel to colours approved by the Architect.

All lagging for cold and hot water pipes erected in crawlways, ducts and above false ceilings which, after erection are not visible from the corridors or rooms, shall be covered with a reinforced aluminium foil finish and banded in colours to be approved by the Architect Services Engineer.

In all respects, unless otherwise stated, the hot and cold water installation shall be carried out in accordance with the best standards of modern practice as described in C.P. 342 and C.P. 310 respectively, to the approval of the Engineer.

(b) **Sanitary Services**

Soil, waste, and vent pipe systems shall be installed in accordance with the best standards of modern practice as described in BS 5572 to the approval of the Services Engineer.

The Sub-Contractor shall be responsible for ensuring that all ground floor waste fittings are discharged to a gulley trap before passing to the sewer via a manhole.

The Sub-Contractor shall provide all necessary rodding and inspection facilities within the draining system in positions where easy accessibility is available.

Where a branch requires, rodding facilities in a position to which normal access is unobtainable, then that branch shall be extended so as to provide a suitable purpose made rodding eye in the nearest adjacent wall or floor to which easy access is available.

The vent stacks shall terminate above roof level and where stack passes through roof, a weather skirt shall be provided. The Sub-Contractor shall be responsible for sealing the roof after installation of the stacks.

The open end of each stack shall be fitted with a plastic coated, or galvanised steel, wire guard.

Access for rodding and testing shall be provided at the foot of each stack.

(c) **Sanitary Appliances**

All sanitary appliances associated with the Sub-Contract Works shall be installed in accordance with the best standard of modern practice as described in BS 6465: Part 1:1984 to the approval of the Architect or Engineer.

**UNDERGROUND INSTALLATION**

(a) **General**

All underground water and drainage service installation shall be carried out in accordance with the best standard of modern practice as described in BS 6700:1987 301 and BS 8301:1985 310 respectively and the following clauses:

(b) **Sequence of Operation for Underground Service Installation**

(1) **Setting Out**

As described in BS Code of Practice 301 Clause 4.6.

(2) **Excavation and Timbering**

As described in BS Codes of Practice 301 Clause 4.7 and the following:

Excavation shall be made to such depths AND dimensions as may be required by the Services 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 Services Engineer.

Should the Sub-Contractor in error or without the instructions of the Services Engineer make any excavation below the required level of the pipe or bed, as the case may be, then he shall be required to refill such excavation to the correct levels with concrete 1:4:8 to 38 mm maximum aggregate size.

The Sub-Contractor's prices shall have included for excavating in all materials met with, for trimming bottoms to the necessary falls and for any extra excavation required for planking and strutting and working space.

The Sub-Contractor shall keep the whole of the trenches or other excavations free from water and shall execute such works and
install such pumps as may be necessary to keep the excavations dry at all times.

3) Laying of Concrete Beds or Other Supports for Pipes (if required)

As described in BS Code of Practice 301 Clause 4.8 and the following:

All drains below buildings and roads shall be encased in concrete 150 mm thick.

Concrete beds and supports shall be concrete 1:3:6 to 25mm maximum aggregate size.

4) Pipe Laying and Joints

Drain pipes shall be laid and jointed as described under BS Code of Practice 301 Clause 4.9.

Pitch fibre drain pipes shall be laid, jointed and cut in accordance with the requirements or the Note contained under Appendix C of BS 2760.

Water pipes shall be laid and jointed as described under BS Code of Practice 310, Clause 401, 402, 402 and 404.

5) 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 Clause 16 of the Specification.

6) Concrete Bedding, Haunching and Surround

Concrete bedding, haunching and surround shall be provided as necessary or where called for by the Services Engineer in accordance with the requirements laid down in BS Code of Practice 301, Clause 4.8.

7) Backfilling

Backfilling of trenches, headings and around manholes shall be carried out in accordance with the methods described in BS Code of Practice 301, Clause 4.16.

8) 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 Architect.

Where excavations have been carried out in public highways or other areas not forming part of the Site, the Sub-Contractor shall be deemed to have allowed in his price for all charges associated with the temporary and final reinstatement requirements of the Local Highway Authority, whether this is carried out by the Sub-Contractor or by the Authority concerned.

No claims for extras in this respect will be accepted.

EXTERNAL PIPE WORKS, PIPE LAYING, BACKFILLING AND ASSOCIATED ITEMS

(i) Where pipes are laid below ground, the main contractor shall carry out all excavation, back-filling, removal of spoil, and making good as specified and as necessary to complete the installatin to the satisfaction of the Engineer and Architect.

The Sub-Contractor shall include for providing all information and marking out as necessary in good time, so that the main Contractor can provide the necessary attendance.

All pipework shall be installed in a neat and workmanlike manner and properly aligned throughout.

Depth of crown of pipe shall not be less than 0.7m, land pipes shall be installed with due regard to clearances from other services installed in the area.

Pipes shall be so arranged as to avoid air pockets, and shall be graded such that the system will vent normally through the installation, or by other approved means.

Trenches shall be of ample dimensions to permit laying and jointing, and pipes shall be bedded in not less than 75mm of sand or other approved material. Filling of the same material shall be hand packed around the pipe a further 75mm above the crown of the pipe, and the whole shall be wall rammed before completion of backfilling, consolidating and making good.

(ii) All drainage pipes shall be laid to continuous and even fall and in accordance with the manufacturer’s recommendations. The pipe trenches shall not be backfilled before the pipes have been tested and approved by the Architect and Engineer.

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 and Architect.

All drains below buildings and small roads shall be incased in 150mm thick concrete (1:3:6). On completion, all drains, manholes, etc. shall be flushed from end to end with water and left clean and free from obstructions.

CONSTRUCTION OF MANHOLES

(i) Manholes shall be watertight and constructed of blockwork 200mm thick on a concrete foundation as shown on the Drawings. Where manholes are likely to receive heavy loads such as roads and access areas, or where they are classed as deep manholes then the blockwork walls shall be reinforced and filled in accordance to the structural engineers Specification. The top of the chamber shall be covered by a reinforced concrete slab with an opening to suit the cover and frame.

(ii) Branch connections to the main drain line shall be made with three quarter section bends which will be mounted on top of the half section channel of the main drain line and shall be swept in the direction of the flow.

(iii) The manhole shall be benched up, sloping at 1 in 10 and rendered and trowelled smooth.

(iv) Manhole covers to BS EN 124 shall be of suitable size to allow complete access, or as indicated on the Drawings.

(v) Manhole covers should be capable of supporting the traffic indicated by the area in which they are situated, or as shown on Drawings.

(vi) The underside of all foul drainage manhole covers and frames exposed to crude sewage vapours shall be suitably protected at the place of manufacture.

(vii) Keys for the purpose of lifting and locking these covers shall be provided, three sets under this contract.

(viii) Before manhole covers are supplied to site, details of all covers are to be submitted to the Engineer for approval.

(ix) Step irons to BS 1247 shall be provided wherever the depth of the access pit requires, and as shown on Drawings.

(x) In manholes that may in the future carry liquid containing acid, the trenches/channels shall be formed by uPVC pipe cut in half horizontally and embedded in the manhole benches.

(xi) The neutralizing chamber shall be constructed as specified above and as shown on the Drawings full details being agreed.

GULLIES
Gullies shall be 100mm PVC trapped type with a 150mm Belfast framed in concrete (1:3:6) of a 100mm minimum thickness, forming a box approximately 300 x 300mm x 100mm above ground. The gullies shall be provided with a light duty cover, to fit in the recess made for this purpose.

shall be made good by the Sub Contractor and the section re-tested.

Drainage Pipes
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.

SANITARY APPLIANCES
The Sub-Contractor is required to supply, install, test and commission the appliances specified elsewhere in accordance with BS 6465:PART 1: 1984. 305 (1974).

The appliances shall be fixed in the position shown on the drawings or as directed by the Engineer.

For all sanitary appliances, the necessary number of supports, brackets, plugs, screws, washers, jointing material, etc. shall be provided by the Sub-Contractor.

Where supports, brackets, etc. are screwed to wall or structure rawl-plugs or similar shall be used.

No trap for any appliances whatsoever shall be with less seal than 75mm.

Fixing shall, if required by the Engineer, include for temporarily erecting appliances in the required position of service and discharge pipes, taking down, storing and permanently fixing after completion of wall finishings and connecting to service and discharge pipes.

Care shall be taken at all times, and particularly after fixing, to protect appliances from damage.

Upon completion of the work, all appliances shall be cleaned for plaster, paint, etc. and carefully examined for defects.

CLEANING
The inside of all pipes, valves, tanks and fittings shall be clean, smooth, and free from blisters, loose scale and dirt, when erected.

SPECIFICATIONS

All lines shall be cleaned after installation and before placing in service.

When pipes are installed all ends shall be suitably plugged until final fixing of fixtures can be carried out. No pieces of cloth of stones will be permitted.

INSTRUCTION PERIOD
The Sub-Contractor shall allow in his pricing for instructing of the use of the equipment to the Client’s maintenance staff. The period of instruction may be within the contract period, but may also be required after the contract period has expired.

The period of time required shall be stipulated but the Client but will not exceed five days, in which time the Client’s staff shall be instructed in the operation and maintenance of the equipment.

WATER STORAGE TANKS
Water storage tanks, unless specified and made from concrete, shall be constructed in metric size panels and shall be as manufactured by Braithwaite. Tanks are to be complete with bracings, supports, box cleats, internal ladder, water level indicator and mosquito proof cover. The mosquito proof cover shall be complete with breather and shall be lockable.

The structural steelwork shall be painted with one coat of red-oxide primer after fabrication. The tank plates shall be painted from outside with undercoat primer and two final coats of gloss paint, and from inside the plates shall be painted with zinc phosphate primer followed by two coats of black bituminous non-toxic paint.

ELECTRICAL SERVICES
Suitably rated control panels shall be supplied and installed as part of this Sub- Contract to meet the starting and operating characteristics of the fan units.

The panels shall be either wall or floor mounted to suit the specific area and requirements. Power supplies to these panels shall be extend from adjacent isolating switches to be provided under the electrical services Sub-Contract. Complete co-ordination shall be maintained with the electrical services Sub-Contractor to ensure supply and termination details are satisfactorily carried out to suit the plant and installations requirements.

Motor Control Panels
All starters, control equipment and the like shall be enclosed in purpose made sheet panels. The panels shall be installed within the plant rooms to suit the dimensions of the actual panels. All details of the panels and layouts within the plant shall be to the approval of the Engineer and shall include:

- Triple pole isolating switch removable neutral link and HRC fuses.
- Control circuit fuses of the HR cartridge type
- Under voltage release, adjustable and complete tower to allow for voltage associated with the KP&L supply and motor starting.
- Over voltage protection, details to be agreed.
- Ammeter of the moving iron mounted on panel with selector switch.
- Pilot lamps, green-run, red-fault.
- Rotary switch for HAND/OFF/AUTO operation, where required.
- Motor winding over-temperature release. The Contractor shall provide this feature in conjunction with the specified thermistor protection.
- Duty selection switches.
- Manual stop-start button units to operate in conjunction with rotary switch.
- Hours run meter/counter.

The Sub-Contractor shall allow at present for the contractors to reclose automatically on the restoration of the mains voltage. This requirement shall be subject to further discussions with the Employer to suit the standby Diesel plant and the mode of operation of essential and non-essential supplies.

All starter panels shall include sufficient miniature circuit breakers, with neutral bar, to supply auxiliary or associated equipment.

All starter panels, motor starters and controllers shall comply with BS 587. Enclosures shall be rigid, at least 1.6mm thick, with rolled corners stiffened as necessary, dust-proof, vermin-proof, damp and corrosion protected with a grey colour stone enamel or other approved finish, fully tropicalised, with washable air filters. Instruments, gauges, ammeters, indicator lamps, etc. shall be flush mounted. Panel doors shall include isolating switches to prevent them being opened unless the switches are in the off position. Each door shall be provided with a lock, and three set of keys for all panel door locks shall be handed over to the Engineer.

2/110
Terminals for all outgoing main and control gables shall be marked and positioned so that the cables may be carried to the outlet from the panel without crossing or being carried round the panel. Terminal numbers and markings shall correspond to those used on connected equipment and wiring diagrams. All internal interconnecting wiring between individual units and the terminal chamber shall be carried out by the panel manufacturer.

Each panel shall be provided with a main isolator so that the whole panel may be completely isolated.

The Sub-Contractor shall determine all motor starter requirements and associated auxiliaries and controls prior to manufacture and shall submit the design and circuit diagrams to the Engineer for approval.

Contractors shall determine all motor starter requirements and associated auxiliaries and controls prior to manufacture and shall submit the design and circuit diagrams to the Engineer for approval.

Contractors shall be of air-break type BS 5424 Part 1 and/or BS 587, and shall be provided as follows:
- Magnetic blow-outs and air chutes on each pole.
- Renewable hard drawn copper contacts.
- Auxiliary contacts for remote control.
- Continuously rated operating coils, (Max. 240V).
- Thermal overload protection device incorporating single phasing protection.

Starters shall be rated as follows:
- Ordinary duty - For motors which will run continuously for periods in excess of two hours.
- Intermediate duty - For motors under automatic control other than time controls. When the intervals of operation are greater than two hours.
- Starters shall be of the following type:
  - Up to and including 400W motor: Single phase on/off with fuse protection.
  - 401-1000W motor single phase direction on line with overload protection.
  - 1001-5.5 kW motor three phase direct on line with overload protection.
  - Over 5.5 kW and up to 50kW: Star Delta starter.
  - For starters incorporating reduced voltage starting the changeover of voltage shall be automatic.

Terminals shall be accessible and shall be provided with adequate clearance between phases and between phases and earth. Where starters are not enclosed in a composite panel, an integral isolating switch as specified for control panels shall be provided. Where electric motors are either not visible from the control panel or are located more than 10m distance they shall be provided with a local lock-off stop control circuit switch, or a main circuit isolator where there is no control circuit. A weatherproof lock-off stop control circuit switch shall be provided for motors located externally or otherwise exposed to the weather.

Motors

Motors shall comply with BS 816 Part 1 and shall be arranged for conduit entry.

Motors shall be fitted with locating type bearings and/or heavy thrust bearings at the non-driven and collar type at the drive end. Motors shall be of the totally enclosed fan cooled type, tropicalised to BS 5000 Part 99 suitably finished to resist corrosion by fluids or fumes. The rating of all motors shall be chosen to provide continuously the maximum power requirements of the plant. The motors shall be of the standard induction type. They may be of the squirrel cage, horizontal or vertical spindle type of all to the approval of the Engineer.

Vertical spindle type motors shall be provided with substantial canopies of approved design.

The locked rotor current shall be stated on the name plate of each motor and shall be not more than six times the full load current.

Thermistors shall be fitted to all motors above 5 kW. The shall be fitted during manufacture and their ends shall be brought out to additional terminals on the connector block of the motor.

All motors shall be rated 3 phases. 415 volt or single phase, 240 volt high power factor continuous maximum rating complying with BS 5000 Part 99 and Class F insulation complying with BS 2757 unless otherwise specified. All motors larger than 1000 kW shall be three phase.

All three phase motors shall be supplied with six stud terminals with each end of the stator phase windings connected, terminals shall be of suitable size to accept the cable lugs of the feeding cables. Terminal blocks shall be mounted on the side of the motor case in an approved box complete with lid, gasket and tapped ET entry hole.

Rubber installation shall not be used on coil connections. Each motor shall be fitted with cable terminal and glands to accept the specified types of cable.

No motor shall run at a speed higher than 1500 rpm unless otherwise specified. Motors driving through Vee-belts shall be fitted with slide rails. The power factor shall not be less than 0.9 lagging. All motors shall be from the same manufacturer as far as possible.

Cabling and Wiring

The Contractor shall carry out all power and control wiring including LV and ELV or any other voltage for the control equipment and alarm systems and interconnecting wiring between starter panels, remove control items, and motor units as required.

Cabling shall be carried out in PVC sheathed, single wire armoured and PVC sheathed overall cable, using compression type glands provided with means of securing armoured wires within the body of the gland, under armour moisture seal and outer sheath seal.

Each core termination shall be fitted with a plastic ferrule engraved with and identification corresponding to the wiring diagrams.

Multicore control cables to the remote stop, start allow water cut-out/alarms shall be 0.62mm² PVC/SPVC where external to the pump station and PVC/PVC or similar, where internal. All cables, whether internal or external being suitably protected.

All conductors shall be copper and the installations, both internal and external being carried out in accordance with the regulations and by-laws previously stated. Trenching and the fixing of cables shall be in accordance with locally specified standards details of which have been specified within the Sub-Contract documents for the electrical services. These details can be made available upon request should the Sub-Contractor not be familiar with these requirements.

Details of the ratings, types and methods for all cables and wiring to be supplied under this Sub-Contract shall be submitted with the tenders, wiring, PVC single core shall be run in either galvanised conduit or galvanised trunking or suitable sizes where surface in plant rooms and heavy gauge PVC were cast into walls, slabs etc.

TESTING AND INSPECTION
SITE TESTS - PIPEWORK SYSTEMS

(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.

A long main shall be tested in sections as the work of laying proceeds and all joints shall be exposed for inspection during the testing.

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 thrust of the water pressure in the main.

If the section of main testing terminates with a sluice valve, the wedge of the valve shall not be used to retain the water; instead the valve shall be fitted temporarily with a black flange, or if a socket valve, with a plug and the wedge shall be placed in the open position while testing. The sub- Contractor shall provide suitable end supports 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 the case of long mains or mains of large diameter, by a power driven test pump which shall not be left unattended. In either case precautions shall be taken to ensure that the required pressure is not exceeded. Pressure gauges should be re-calibrated before the tests.

The Sub-Contractor shall be deemed to have included in his price for all test pumps and other equipment required under this Clause of the Specification.

The test pressure shall be one and a half times the maximum working pressure except where a pipe is manufactured from a material for which the relevant BS Specification designates a maximum test pressure as in the case of cast or spun iron pipes, where the test pressures should not exceed 120, 180 and 240 metre/thead for Classes B, C or D pipes, respectively.

The test pressure shall be maintained by the pump for about one hour if there is any leakage, it shall be measured by the quantity of water pumped into the main at that time. A general leakage of one gallon per 24 hours per 30 metres head, may be considered reasonable but any visible individual leak shall be repaired.

(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 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 Services Engineer.

During the test, each branch and joint shall be examined carefully for leaks and any defects revealed shall be made good by the Sub-Contractor 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.

(c) Above Ground Soil Waste and Ventilation Pipe Systems

All soil, waste and ventilating pipe systems forming part of the above ground installation, shall be given an air test to a pressure of 38mm of water gauge and this pressure shall remain constant for a period of not less than three minutes.

Water tests on above ground level, 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 Services Engineer.

In all other respects, tests shall comply with the requirements of BS 5572.

STERILISATION

On completion of the domestic water services and after all testing is complete, the entire installation, the definition of which is to be agreed with the Engineer, shall be thoroughly and efficiently sterilised. Prior to the sterilisation, the Sub-Contractor shall first inspect all storage tanks and remove any debris found therein.

The Sub-Contractor shall arrange for the sterilisation to be carried out by a specialist firm. The Sub-Contractor shall notify the local water authority and the Engineer as to when the sterilisation is to be undertaken.

Warning notices shall be displayed at every outlet on the system and on all relevant control valves.

All storage tanks shall be inspected to ensure that all debris has been removed. All storage tanks, calorifiers and hot and cold distribution services, including pumped services where applicable, shall be thoroughly flushed with clean water to remove detritus and air. The storage tanks shall then be refilled and, whilst filling, an appropriate sterilant containing chlorine shall be added gradually to ensure thorough dispersal. This sterilant is to be approved by the local water authority. Sufficient sterilant shall be added to obtain a minimum dosage level of 50 parts of free chlorine to one million parts of water (50 p.p.m.).

All chlorine levels must be determined chemically and this may be by comparator method. If Chlorox is used, 0.5 litres of chemical added per 1,000 litres of water should be sufficient to obtain this dosage level.

All calorifiers, hot and cold distribution services, and each outlet not served by storage tanks within this system, shall be sterilised by injection. Whilst sterilant is being injected, all services and outlets shall be run until the chlorine level in and at each of these is above 50 p.p.m. This is to be carried out without risk of contamination to the existing system.

The entire mains water system and drinking water system (if not tank fed) shall be sterilised by injection. Whilst sterilant is being injected, all services and outlets shall be run until the chlorine level in and at each of these is above 50 p.p.m. This is to be carried out without risk of contamination to the Statutory Authority’s mains or, where applicable, the existing system.

The entire system shall be left fully charged and with a chlorine concentration of not less than 50 p.p.m. throughout. The Sub-contractor shall be responsible for maintaining the system in this condition and ensuring that no water is drawn from it by others. At this stage, all cistern lids and storage tank covers must be in their fixed positions and remain so from this point onwards. After a contact period of not less than three hours, tests for residual chlorine shall be carried out at random points on each system. If any of these tests reveal that the chlorine level has dropped below 20 p.p.m., the sterilisation programme shall be repeated until satisfactory levels are
obtained. The entire system shall be left undisturbed for a further twelve hours.

Upon successful completion of the sterilisation, the entire installation shall be thoroughly flushed until the chlorine level throughout each system and every outlet is below 0.3 p.p.m.

The Sub-Contractor shall ensure that the effluent is directly discharged to main foul drainage and that it complies with the local water authority's effluent discharge regulations. This may require the dechlorination of the effluent by approved chemical methods and this work shall be carried out by the specialist sub-contractor.

The warning notices shall be removed.

The Sub-Contractor shall arrange for samples of water to be taken for bacteriological analysis after all flushing is complete.

The techniques for sampling and examination to ensure proficiency of laboratory practice, and compatibility of results and the interpretation of these results, shall be recommended in H.M. Government’s report entitled "The Bacteriological Examination of Drinking Water Supplies 1982".

The samples shall be obtained from a suitable test point from each of the services detailed below, where applicable.

a) Mains water service entering the site;

b) Extremity of the mains water distribution service;

c) Extremity of the drinking water distribution service;

d) Extremity of the cold water distribution service;

e) Extremity of the hot water distribution service.

The biological examination of each and every sample must show the waters to be conclusively determined to be of poor quality, and this must be confirmed by the local water authority.

The Sub-Contractor shall obtain from the specialists, appropriate reports and certificates relating to the sterilisation programme, and bacteriological examinations and forward these to the Engineer.

The Sub-Contractor, in his tender, shall allow for all costs relating to sterilisation, bacteriological analysis, and water usage during the sterilisation.

VALVE AND PIPE IDENTIFICATION

All valves, except where adjacent to draw-off points, shall be fitted with a 60mm diameter 'Traffolyte' disc with a ring. The disc shall be engraved as required for identification purposes, the engraving being black on a white background.

A list of valves as identified above shall be scheduled numerically by the Sub-Contractor and handed to the Engineer at the end of the contract. A valve chart shall be installed in all appropriate plant rooms in accordance with the Engineer's requirements.

Unless stated otherwise in the Particular Specification all pipework shall be colour coded in accordance with the latest edition of BS 1710.

INSPECTION TESTING AND COMMISSIONING

INSPECTION FOR COMPLIANCE WITH REGULATIONS

Throughout the execution of the works, the Contractor shall be responsible for ensuring compliance with the requirements stated in this specification and all relevant standards and regulations and shall notify the Engineer of any infringements which directly or indirectly detract from the safe and satisfactory operation of the installation(s) whether or not such infringements relate to the associated works of others.

TESTING AND COMMISSIONING - DEFINITIONS

The Contractor shall carry out the testing, commissioning, proving and putting to work all installations comprising the contract works.

For the purpose of this specification the following definition shall apply:

The Contractor shall give the Engineer 7 days written notice of his intentions to carry out the proving of any tests or commissioning and shall have carried out all necessary adjustments prior to commencing proving.

The Contractor shall supply all fuel, water, power, labour, apparatus and instruments necessary for the prescribed tests. The accuracy of the Contractor's instruments shall be demonstrated if required.

Any defects of workmanship, materials, performance, design of equipment, adjustments or other irregularities which become apparent during the tests shall be rectified by the Contractor and the tests repeated at the contractor's expense, to the satisfaction of the Engineer.

(1) Off-site Tests: tests carried out on items of equipment at manufacturer's works or elsewhere to ensure compliance with the requirements of specification and/or relevant British Standards or Codes of Practice.

Where an individual inspection or test takes place at a manufacturer's works a representative of the Contractor and the engineer will normally be required to be present.

(2) Site Tests: tests on static and system e.g. inspection and testing of welded, hydraulic testing of pipework, etc. to ensure correct and safe installation and operation.

(3) Commissioning: the advancement of an installation from the stage of static completion to full working order to specified requirements. This will include setting to work and regulation of the installation.

(4) Setting to work: the process of setting a static system into motion.


Particular care shall be taken to ensure that the electrical equipment and components are kept clean and dry.

Before installations are handed over or subjected to the inspection and tests required, the entire installation shall be thoroughly cleaned, both internally and externally. Arrangements to ensure cleanliness of air and water systems shall follow the recommendations in the relevant CIBSE Commissioning Codes and where indicated chemical cleaning of water systems shall be carried out.

All water installations shall be flushed out with clean water. This shall be preceded by chemical cleaning where indicated. During the flushing out process provision shall be
made to exclude filters, pumps and any other items of plant which could be damaged by the cleaning operation. The entire operation shall be carried out to the satisfaction of the Engineer.

SITE TESTS

The Contractor shall be responsible for site tests on static systems in order to ensure safe operating conditions consistent with design performance. Such tests shall include inspection and testing of welds and pressure testing for soundness of hydraulic systems.

On completion of the pre-commissioning cleaning of the domestic hot water installation, the system shall be recharged with clean water and then subjected to a hydraulic test of 1.5 times the working pressure for a period of not less than 1 hour. Items of equipment, e.g. safety valves, set to operate at or below this test pressure shall be isolated or removed prior to applying the test. When the installations have been proved pressure tight they shall, as appropriate, be drained and recharged.

On completion of the pre-commissioning cleaning of each cold water installation, the system shall be recharged with clean water and then tested as follows. Storage cistern and distribution pipework shall be absolutely watertight under working conditions or pressure with all draw-off taps closed. Water mains and service pipework shall be subjected to a hydraulic test pressure of 6 bar (61.18m head) or 1.5 times the maximum working pressure, whichever is the greater. This pressure shall be maintained without measurable loss for at least 1 hour.

All pressure tests as specified above shall be carried out before the application of thermal insulation, but where this would prejudice the completion of the insulation the section concerned shall be individually tested before the application of the insulation.

Tanks, cylinders, pumps, etc., specified to comply with BS shall be subject to such tests at works as are provided in the BS. Where there is no BS, such plant shall be subjected to a hydraulic test of 15 times the maximum working pressure, for a period of 30 minutes.

The certificates for work tests required by the Engineer shall be submitted in duplicate to the Engineer.

COMMISSIONING

All aspects of the commissioning procedure shall follow the recommendations in the relevant CIBSE Commissioning Codes.

Commissioning shall include:-

1. Preliminary checks to ensure that all systems and system components are in a satisfactory and safe condition before start up.
2. Preliminary adjustments and setting of all plant and equipment consistent with eventual design performance.
3. Energising and setting to work all plant.
4. Final regulations and demonstration that the installation delivers the correct rate of flow of fluids at the conditions specified in the contract documents.

The entire commissioning procedure shall be performed to the satisfaction of the Engineer. The results of the commissioning shall be recorded by the Contractor and shall be endorsed by the Engineer. The items on the certificate shall be read in conjunction with the appropriate clauses of this specification and the designs requirements of the drawings and the certified results and statements pertaining to the commissioning procedure shall be interpreted accordingly.

INSULATION

All pipework shall be covered with Class ‘O’ ‘Armaflex’ insulation as manufactured by Armstrong World Industries Ltd or equal and approved alternative. Insulation thickness to comply to BS 6780. Insulation to be installed as manufacturer’s instructions.

Insulation materials containing asbestos or flammable materials such as polystyrene or polyurethane shall not be used.

Particular attention shall be given to the finished appearance of all firm insulation which must present a neat and symmetrical appearance running true in line with the pipe layouts and on all other items comprising the works. Any rough, irregular or badly finished surface shall be stripped down and re-insulated to the satisfaction of the Engineer at the Building Services Contractors own expense.

The Contractor shall not apply any insulation to the work until the systems have been fully tested and witnessed and approved by the Engineer.

Each pipe shall be insulated separately and adjacent parallel pipes shall not be married together in one insulation covering.

The Contractor shall be responsible for the supply, installation, and leaving in working order, the whole of the insulation installation as specified herein, to the complete satisfaction of the Engineer.

CO-ORDINATION, DRAWINGS AND RECORD DOCUMENTS

Co-ordination

In respect of building services the contractor shall work from the drawings and specifications provided by the Engineer, the Contractor shall co-ordinate and if necessary produce drawings as may be required for the proper co-ordination of the whole works with respect to other services. Whether new or existing and with the structure and layout of the buildings.

These drawings show the design intent having taken into account the buildings and all service so that plant rooms, service voids and ducts are adequate for the accommodation of plant and services.

All valves, traps, vents, automatic controls and dampers shall be placed in accessible locations.

The Contractor shall keep one set of drawings on site, upon which he shall indicate progressively the extent of the works as installed. These drawings shall be kept solely for this purpose and shall be available for inspection at all times.

As Installed Drawings, Maintenance Manuals and Test Certificates

The Contract shall not be accepted for completion nor a Completion Certificate issued until the draft record drawings and O&M Manuals have been received and approved by the Engineer.
PART 25
ARCHITECTS SPECIFICATIONS
PART 25 GENERAL SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

25.1 General Electrical Specification

The work shall be carried out as described in this specification and as shown on the drawings which are to be read together with each other.

If applicable Engineering Consultants Specifications will take precedence over these specifications.

The sub-contractor will be required to liaise with the Kenya Power & Lighting Company Limited in order to determine the most appropriate and the most economical method of bringing in the service line cable, which is considered acceptable by the Authority. Any changes required to the proposed position of the service ducts will be advised through the Architects and the service ducts will be advised through the Architects and it shall be ensured that this work is carried out to the requirements of the power supply company.

The sub-contractor carrying out the electrical installations work will be registered with the Ministry of Energy under an appropriate class of registration and shall be authorised to issue a Commencement of Work Notice and a Completion Certificate once the installation work has been completed. He must be conversant with the last statutory requirements of the Kenya Power & Lighting Company Limited to ensure that only the installation practice acceptable to them is them is followed. The statutory requirements shall over- rule the requirements stipulated in the I.E.E. Regulations for the electrical equipment of buildings, 14th Edition issued by the I.E.E.London, which shall generally be the basis for the electrical installation work through out.

The sub-contractor shall allow for liaising with the Kenya Power & Lighting Company Limited to ensure that the electricity supply is made available by the Company at the appropriate time and to suit the programme of construction work. An enquiry for a Supply of Electricity supply Form shall be submitted to the power supply company giving details of the electrical installations.

25.2 Submain cables

PVC insulated single core cable shall be supplied by the sub-contractor. The cables shall be drawn in heavy gauge high impact PVC conduits such that a space factor of 45% is not exceeded. No conduit shall contain more than three circuits (pairs of cables) single phase a.c; 3 cables per circuit, or 4 where one is neutral; 3 phase a.c). Suitable number and sizes of draw-in boxes shall be supplied and installed enroute of cables, where necessary, to facilitate drawing of cables.

Cables shall not be jointed at intermediate positions in between the switchgears.

Conduits for cables shall be laid with a minimum of 300mm clearance from any other service pipes including lagging if any. Where it is found that this condition cannot be complied with the Engineers shall be advised prior to installation being commenced.

Cables of appropriate colours shall be used, distinctly indicating different phases of the supply voltage.

PVC SWA PVC copper conductor cables to BS6346 including brass compression glands shall be provided by the sub-contractor in accordance with the layout drawings and the schematic wiring diagrams.

25.3 Distribution Boards and Consumer Units

All the distribution boards and consumer units are indicated on the drawings. At the positions indicated, the sub-contractor shall supply and install the switchgear of the type and rating as specified on the drawings. The MCB units on distribution boards G1 and G2 shall be rated at 10KA.

The distribution boards and consumer units shall be from one manufacturer, locally assembled where necessary, by an approved supplier. Such a supplier shall be able to provide a guarantee of being able to stock and provide adequate spares for at least five years.

The consumer unit in the offices shall be fixed flush with the wall whereas distribution boards shall be fixed on surface.

An independent earth continuity conductor shall be provided at each distribution board and consumer unit.

25.4 Lighting installations

From the MCB panels or sub-boards the sub-contractor shall supply and install PVC cables enclosed in:

- Metal trunking and HG high impact PVC conduit fixed on surface for lighting installations in the Warehouses. The vertical drops for wiring to switches shall be galvanised steel conduit.
- Heavy gauge high impact PVC conduit concealed in the fabric of the building in all the remaining areas except those above installations which will be exposed to rain and where only galvanised steel conduit shall be used.

The conduit layout throughout shall be such that rewiring of the lighting circuits will be possible without disturbing the building fabric. The sub-contractor is advised to examine the relevant Architects’ and Structural Engineer’s drawing for detailed plans and sections of the building.

The height above floor of wiring accessories shall be checked with the Architects before commencing installation work.

The tenderer shall allow in his price for supplying installing, connecting, wiring and testing of all the specified light fittings complete with lamps of appropriate wattage and colour rendering. All fixings and suspensions. Sample of each type of light fitting shall be submitted for the approval of the Engineer.

25.5 Power Installations

From the MCB panels or sub-boards the sub-contractor shall supply and install PVC cables enclosed in:

HG high impact PVC conduit concealed in the fabric of the building for power installations in the Warehouses and offices.

To various power outlets, 13 amps switched socket outlets in the warehouses shall be Mk 2977 ALM whereas in the remaining areas, they shall be provided 200mm above the worktops or finished floor levels unless indicated to the contrary. All cable trunking shall be fabricated.
from 18 SWG galvanised sheet steel. Linking trunking and conduits to the Consumer Units and between any two section of the trunking shall be provided by the sub-contractor and they shall be equal in capacity to the cable carrying capacity of the connecting compartments. Suitable adaptable boxes where necessary shall be provided behind the metal cable trunking in order to link the conduits in a manner agreed with the Engineer.

A sample of the metal cable trunking shall be submitted for the approval of the Engineer before commencing fabrication.

The copper e.c.c. shall be in accordance with Table D.2.M. of the I.E.E. Regulations for the Electrical Equipment of Buildings - 14th Edition. All metal boxes shall be provided with e.c.c.

25.6 Telephone Conduit Installations

Telephone outlets positions are shown on the drawings. The sub-contractor shall provide the necessary HG PVC conduits for the KP&T Corporation to carry out the wiring and installation of equipment. A minimum size of 20mm dia conduit with intermediate draw-in boxes where necessary shall be run to various outlet positions, where such outlets are not indicated on the metal cable trunking. Not more than three telephone outlet positions shall be connected to each 20mm dia conduit. Each conduit shall be provided with a draw-wire. Telephone cord outlet plates shall be MK 427 WH1 or equal approved.

25.7 Security Lighting Installations and Area Lighting

The layout of external security lighting and area lighting installations is shown on the layout drawing. The sub-contractor shall provide lighting fittings in compliance with the details shown on the relevant drawings. The outreach bracket shall be primed and after installation painted to the approval of the Engineer.

The cabling to various lighting fittings Type 'D' shall be PVC SWA cables of the size and type as shown on the drawings. The cables shall generally be laid direct in ground at a depth of 500mm with 50mm sand bed under and over and provided with Danger Hatari concrete tiles throughout their length. Where cables cross roads or permanently finished surfaces these shall be drawn through PVC or concrete ducts. Type K light fittings shall be wired in galvanised conduit. The cables at the positions of the lighting fittings shall be terminated by using brass compression glands.

The lighting installations with light fittings Type K shall be controlled by means of photoelectric cell operating a suitably rated contactor.

25.8 Fire Alarms System

The sub-contractor shall be responsible for supplying, installing, wiring and commissioning the complete Fire Alarm System in each unit. The Fire alarm system in each unit shall be independent and shall not be connected to other units.

The system shall consist of manual break-glass points, bells, optical smoke detectors and a fire alarm panel complete with charger and batteries installed in the positions shown on the drawings. The fire alarm panel shall be connected to 240v, 50Hz A.C. panel supply through a 13 amps metal clad unswitched fused spur unit incorporating a pilot light.

The system shall work in the event of signal being installed from any optical smoke detector or break-glass contact and all bells shall ring simultaneously. The bells shall continue ringing until manually reset at the panel.

On silencing the bells, the buzzer within the panel shall remain operative until such time that the glass for the break-glass contact has been replaced.

The wiring to call initiating points shall be carried out in 1.5mm² and to bells shall be done in 2.5mm² PVC cables, enclosed in steel conduit or impact concealed conduit. A completely separate and independent conduit system shall be used for wiring to fire alarm equipment.

The operation of Fire alarm system on completion shall be demonstrated to the Engineer and the client and one copy of the Operating Instructions shall be provided to the Engineer and two copies to the client.

25.9 Testing

On completion, the installation must be tested in accordance with Section E of the I.E.E. Regulations for the electrical equipment of buildings and the sub-contractor must allow for preparing a test report for submission to the Engineers and the Kenya Power & Lighting Company Limited.

25.10 Earthing

The earthing of the installations shall comply with Section D of the I.E.E. Regulations for the Electrical Equipment of Buildings 14th Edition and in accordance with the requirements of Kenya Power & Lighting Company Limited.

25.11 Commissioning

The entire electrical installation shall be commissioned and all items of switchgear, socket outlets, light fittings, motor starters shall be checked for correct functioning before handing-over.

25.12 Handing Over

After testing and commissioning the sub-contractor shall hand-over the entire installation together with “as built” drawings etc. Clear away all debris and surplus materials leaving all work sites in clean and tidy state.

25.13 Light Fittings

All the specified light fittings shall be supplied complete with lamps of appropriate wattage and colour rendering. The fluorescent lamps unless otherwise indicated shall be of "warm-white" type.

NOTES

1) Samples of each type of light fitting to be submitted for approval before placing orders with the suppliers.

2) All fluorescent light fittings and discharge lighting fittings shall be of power factor corrected type.

3) All light fittings shall be supplied complete with lamps of appropriate voltage, wattage and colour rendering.

SPECIFICATIONS

SPECIFICATIONS ELECTRICAL INSTALLATIONS
### SECTION NO 3

**TUITION BLOCK TYPE 02**  
(6NO CLASSROOMS)

**ELEMENT NO 1**

**SUBSTRUCTURES (ALL PROVISIONAL)**

#### Site Preparation

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<tr>
<th>Item</th>
<th>Quantity</th>
<th>Rate</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>A Chemical anti-termite treatment to subsoil or fillings: Dragnet 38% E.C. or other equal approved: provide ten year guarantee</td>
<td>m²</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td><strong>Excavation</strong> (Provisional)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Excavate to reduce levels not exceeding 1.5 metres deep</td>
<td>m³</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>C Excavate trenches for wall foundations: commencing from reduced level: not exceeding 1.5 metres deep</td>
<td>m³</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>D Excavate for column pits: ditto</td>
<td>m³</td>
<td>31</td>
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</tr>
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**Disposal of excavated materials** (Provisional)

<table>
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<th>Item</th>
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<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>E Selected excavated material in filling to make up levels under floor bed: placed in 200 mm layers: watered and compacted to 95% MDD</td>
<td>m³</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>F Remove surplus excavated material and deposit on site</td>
<td>m³</td>
<td>244</td>
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**Disposal of water**

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<tr>
<td>G Keep excavations free from all water</td>
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**Planking and strutting**

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<th>Quantity</th>
<th>Rate</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>H Planking and strutting to sides of all excavations: keep excavations free from all fallen materials</td>
<td></td>
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**Hardcore**

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<tr>
<td>J Hardcore Filling: deposited, spread, levelled and compacted in 200 mm dept: to 95% MDD</td>
<td>m³</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>K 50 mm quarry dust or murram blinding</td>
<td>m²</td>
<td>322</td>
<td></td>
</tr>
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#### Carried to Collection

**KSHS**

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**Section No. 3**  
**TUITION BLOCK TYPE 02**  
**Element No. 1**  
**SUBSTRUCTURES**  
170  
**M&A**
<table>
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<th>Rate</th>
<th>Amount Shs</th>
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<tr>
<td>A</td>
<td>Insitu concrete : grade C15</td>
<td>m^2</td>
<td>88</td>
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</tr>
<tr>
<td>B</td>
<td>50 mm Blinding layer : under foundations</td>
<td>m^2</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Foundations in trenches</td>
<td>m^3</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Column bases</td>
<td>m^3</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Columns</td>
<td>m^3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Insitu concrete : grade C25 : vibrated : reinforced</td>
<td>m^2</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>150 mm Surface bed</td>
<td>m^2</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Mesh fabric reinforcement to BS 4483: 200 mm laps</td>
<td>m^2</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Fabric mesh reinforcement A142 : in surface beds</td>
<td>m^2</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Type 2 Deformed steel bar reinforcement Grade 460MPa to BS 4449:2005</td>
<td>kg</td>
<td>3,500</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>8-16 mm Diameter bars</td>
<td>m^2</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Vertical sides : column bases</td>
<td>m^2</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Vertical sides : foundations</td>
<td>m^2</td>
<td>6</td>
<td></td>
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<tr>
<td>N</td>
<td>Vertical sides : column bases</td>
<td>m^2</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Edges of surface slab : over 75 but not exceeding 150 mm high</td>
<td>m</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>Stone load bearing block walling 3.5 N/mm² : in cement mortar (1:4)</td>
<td>No</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Labours and sundries</td>
<td>m^2</td>
<td>140</td>
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KSHS

Section No. 3
TUITION BLOCK TYPE 02
Element No. 1
SUBSTRUCTURES
170
M&A
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<th>Description</th>
<th>Quantity</th>
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<th>Amount Shs</th>
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<tbody>
<tr>
<td>A</td>
<td>One layer 500 gauge polythene sheet damp proof membrane: under bed: 300 mm laps: sealed with tape</td>
<td>m²</td>
<td>322</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damp proof courses: bituminous felt: bedded in cement and sand mortar (1:4): 300 mm laps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Horizontal: 200 mm wide</td>
<td>m</td>
<td>147</td>
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Section No. 3  
TUITION BLOCK TYPE 02  
Element No. 1  
SUBSTRUCTURES  
170  
M&A

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KSHS
### Section No. 3

**Element No. 1**

**SUBSTRUCTURES**

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Section No. 3
TUITION BLOCK TYPE 02
Element No. 1
SUBSTRUCTURES
170
M&A

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<td>TUITION BLOCK TYPE 02</td>
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<td>(6NO CLASSROOMS)</td>
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<tr>
<td>ELEMENT NO 2</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>R.C SUPERSTRUCTURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insitu concrete : grade C25 : vibrated : reinforced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Columns</td>
<td>m3</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>B Beams</td>
<td>m3</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>C Ring Beams</td>
<td>m3</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>D 150 mm Thick suspended slab</td>
<td>m2</td>
<td>496</td>
<td></td>
</tr>
<tr>
<td>Type 2 Deformed steel bar reinforcement Grade 460MPa to BS 4449:2005.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E Assorted sizes : 8-25 mm diameter</td>
<td>kg</td>
<td>17,500</td>
<td></td>
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<tr>
<td>Sawn formwork : to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Vertical sides : columns</td>
<td>m2</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>G Sides of beams</td>
<td>m2</td>
<td>236</td>
<td></td>
</tr>
<tr>
<td>H Sides of ring beams</td>
<td>m2</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>J Horizontal soffits : suspended slabs</td>
<td>m2</td>
<td>496</td>
<td></td>
</tr>
<tr>
<td>K Vertical edge of suspended slab : over 75 but not exceeding 150 mm high</td>
<td>m</td>
<td>150</td>
<td></td>
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Carried Forward to Summary of Section No. 3

Section No. 3
TUITION BLOCK TYPE 02
Element No. 2
R.C SUPERSTRUCTURE
170
M&A

KSHS
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<td>ELEMENT NO 3</td>
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<tr>
<td>STAIRCASES &amp; RAMPS</td>
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</tr>
<tr>
<td>STAIRCASES</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Insitu concrete : class C25 : vibrated : reinforced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Steps, risers and waists</td>
<td>m3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>B 150 mm Suspended landings</td>
<td>m2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Type 2 Deformed steel bar reinforcement Grade 460MPa to BS 4449:2005.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 8-12 mm Diameter bars</td>
<td>kg</td>
<td>650</td>
<td></td>
</tr>
<tr>
<td>Sawn formwork : to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D Horizontal soffits : suspended landings</td>
<td>m2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>E Sloping soffits : staircases</td>
<td>m2</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>F Vertical edge of risers : over 150mm but not exceeding 225 mm high</td>
<td>m</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>G Ditto : open string edge 300mm (extreme) wide : cut to profile of treads and risers</td>
<td>m</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Cement and sand (1:4) screeds : steel trowelled : on concrete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H 25 mm floors to receive timber floor finish</td>
<td>m2</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>12mm Lime plaster : steel trowelled finish : on concrete : to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J Horizontal soffits : landings</td>
<td>m2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>K Sloping soffits : staircases</td>
<td>m2</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>L Vertical edge : open string edge to steps 300mm (extreme) wide</td>
<td>m</td>
<td>17</td>
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**Carried to Collection**

KSHS
## Proposed Tuition Block Type 02

**For Kenya Medical Training College**

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<td>A</td>
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</tr>
<tr>
<td>B</td>
<td>m</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>m</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>m</td>
<td>11</td>
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</tbody>
</table>

**Non-slip Ceramic floor tiles with borders:** allow for purchasing as selected by the Architect: take delivery: transport to site, store and lay: bedded on cement and sand screed measured separately: jointed and grouted in coloured imported proprietary grout:

- **A** Landings
- **B** Ditto: 300 mm Wide tread with non-slip insert
- **C** Ditto: 190 mm high riser
- **D** 100 mm high skirting

**Prepare and apply three coats 1st grade emulsion paint:** to

- **E** Plastered horizontal soffits: landings
- **F** Plastered sloping soffits: staircases
- **G** Plastered sloping vertical edge: waists to steps

**Ramps**

- **H** Insitu concrete: class C25: vibrated: reinforced 150 mm Suspended Slab
- **J** Type 2 Deformed steel bar reinforcement Grade 460MPa to BS 4449:2005. 8-20 mm Diameter bars
- **K** Sawn formwork: to
- **L** Ditto: edge of slab: exceeding 150 mm and not exceeding 225 mm high

**Cement and sand (1:4) screeds:** steel trowelled: on concrete

- **M** 50 mm tamped screed finish.
- **N** 12 mm Lime plaster: steel trowelled finish: on concrete: to

**Carried to Collection**

KSHS 170

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Section No. 3
TUITION BLOCK TYPE 02
Element No. 3
STAIRCASES & RAMPS
M&A
### PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

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<tr>
<td>A</td>
<td>m²</td>
<td>78</td>
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<td></td>
<td>Prepared sloping soffits: ramps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>RAILINGS</strong></td>
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<tr>
<td></td>
<td>Balustrades and Railings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Balustrades and Railings comprising 50 x 50 mm SHS m.s handrail on 35 x 35 mm RHS balusters at 2000 mm centres, fish tailed and cast into concrete: 50 x 5 mm base plate: 2 No. 35 x 35 mm SHS diagonal intermediate rails: welded smooth and gloss painted: to Architects details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>m</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>m</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>900 mm high: Staircases</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>900 mm high: Ramps</td>
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**Carried to Collection**  
KSHS

Section No. 3  
TUITION BLOCK TYPE 02  
Element No. 3  
STAIRCASES & RAMPS  
170  
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17/06/2020
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-3/3/4-
## SECTIN NO 3

TUITION BLOCK TYPE 02
(6NO CLASSROOMS)

### ELEMENT NO 4

**ROOFING**
(RWG in Plumbing BoQs)

**Roof cover**

Metal roofing tiles (roof tile look) : fixed to manufacturer's detail : on purlins (ms) : fixed approximately : to Engineers detail

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<tr>
<td>A</td>
<td>m²</td>
<td>395</td>
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<tr>
<td>B</td>
<td>m</td>
<td>29</td>
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**Roof Structure**

Structural timbers : sawn cypress Grade II : pressure impregnated

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<tbody>
<tr>
<td>C</td>
<td>m</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>m</td>
<td>335</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>m</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>m</td>
<td>164</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>m</td>
<td>306</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>m</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>m</td>
<td>96</td>
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Prepare and apply one undercoat, one coat 1st grade plastic emulsion paint and top coat washable Crown Solo Pure Satin Emulsion paint : to

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<td>K</td>
<td>m²</td>
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Section No. 3
TUITION BLOCK TYPE 02
Element No. 4
ROOFING

170
M&A
## SECTION NO 3

### TUITION BLOCK TYPE 02

(6NO CLASSROOMS)

### ELEMENT NO 5

### WALLING

Selected load bearing (3.5N/mm²) machine cut stone walling to Architect's approval in 200 mm course heights : in cement mortar (1:4)

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<tr>
<td>A</td>
<td>200 mm Walls externally</td>
<td>m²</td>
<td>382</td>
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<tr>
<td>B</td>
<td>Ditto : parapet</td>
<td>m²</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Ditto : Internally</td>
<td>m²</td>
<td>329</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>100 mm Walls internally</td>
<td>m²</td>
<td>63</td>
<td></td>
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### Carried Forward to Summary of Section No. 3

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<td>WALLING</td>
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<td>M&amp;A</td>
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<tr>
<td>Item No</td>
<td>Quantity</td>
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<td>TUITION BLOCK TYPE 02 (6NO CLASSROOMS)</td>
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<tr>
<td>ELEMENT NO 6</td>
<td>WINDOWS</td>
<td></td>
</tr>
<tr>
<td>50 mm thick stone sill with rounded edge : 10 mm diameter throat and drip on one side : bedded, jointed and pointed in cement mortar (1:4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>25 mm Thick window sill 225 mm wide : splay cutting stone wall m</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Steel casement windows : comprising 50 x 25 mm m.s frame; 20 x 15 mm mullions : 5 mm thick glass : frosted, obscure or clear : permavents : windows with proprietry projected out type : friction stays : Supply and fix 'Union' ironmongery or equal and approved : fixed to block work or concrete : to Architect's detail</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Window overall size 450 x 900 mm high No</td>
<td>27</td>
</tr>
<tr>
<td>C</td>
<td>Window overall size 1200 x 1500 mm high No</td>
<td>42</td>
</tr>
<tr>
<td>C</td>
<td>Prepare, prime and apply two undercoats and one finishing coat spray painted anti-corrosive paint on metal</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Windows : both sides measured m2</td>
<td>173</td>
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Section No. 3
TUITION BLOCK TYPE 02
Element No. 6
WINDOWS
170
M&A

KSHS

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17/06/2020
### PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

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<tr>
<td>ELEMENT NO 7</td>
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</tr>
<tr>
<td>DOORS</td>
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45 mm Panelled Solid core Flush doors: mahogany veneer facing to both sides: hardwood lipping all edges: 10 x 10 mm planted beading to both sides: 10 mm decorative aluminium insert beading at 580 mm centres: to Architects detail

A Single door overall size 800 x 2100 mm high No 21
B Single door overall size 900 x 2100 mm high No 12

Wrot Hardwood: Mahogany: prime grade: knot free: selected and kept clean:

C 25 mm Quadrant beading m 167
D 50 x 25 mm Moulded architrave: two labours m 167
E 100 x 50 mm Transome: ditto m 11
F 100 x 50 mm Frame: two labours: plugged, screwed and pellated m 157

Timber Doors Ironmongery

Supply and fix the following ironmongery as 'Union Assa Abbloy' or equal and approved: to Architect's approval

G 100 x 76 x 2 mm Brass ball bearing hinges Pairs 49.5
H 5 lever lock No 12
J Brass Quarter Door Stoppers No 12
K Indicator Bolts No 21
L Male/Female Symbols No 6

Carried to Collection KSHS

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<tr>
<td>A</td>
<td>m</td>
<td>167</td>
<td></td>
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<tr>
<td></td>
<td>Prepare and prime before fixing : on woodwork</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>m</td>
<td>167</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepare and apply three coats white gloss oil paint : on wood work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>m²</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>m</td>
<td>167</td>
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</tr>
<tr>
<td></td>
<td>Frames : over 200 and not exceeding 300 mm girth</td>
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Section No. 3
TUITION BLOCK TYPE 02
Element No. 7
DOORS
170
M&A

KSHS

17/06/2020
Section No. 3  
Element No. 7  
DOORS  
**COLLECTION**  

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Section No. 3  
TUITION BLOCK TYPE 02  
Element No. 7  
DOORS  
170  
M&A  

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17/06/2020
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**SECTION NO 3**

**TUITION BLOCK TYPE 02**
(6NO CLASSROOMS)

**ELEMENT NO 8**

**BALUSTRADES & RAILINGS**

Balustrades and Railings comprising 50 x 50 mm SHS m.s handrail on 35 x 35 mm RHS balusters at 2000 mm centres, fish tailed and cast into concrete: 50 x 5 mm base plate: 2 No. 35 x 35 mm SHS diagonal intermediate rails: welded smooth and gloss painted: to Architects details

A 900 mm high: Walkway

m 85

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**Carried Forward to Summary of Section No. 3**

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<td>BALUSTRADES &amp; RAILINGS</td>
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## Section No. 3

### Tuition Block Type 02

(6NO Classrooms)

### Element No. 9

**Internal Finishes**

#### Floor Finishes

- **A** 32 mm Floors: finished to receive ceramic floor tiles
  - Quantity: m²
  - Rate: 728

- **B** 300 x 300 x 10 mm Floor tiles
  - Quantity: m²
  - Rate: 728

- **C** 100 mm high skirting
  - Quantity: m
  - Rate: 581

#### Wall Finishes

- **D** 12 mm Lime plaster: steel trowelled finish: on concrete, blockwork or stonework: to
  - Quantity: m²
  - Rate: 1,167

- **E** 450 x 250 x 8 mm thick (1.5m height)
  - Division strips
  - Quantity: m²
  - Rate: 225

- **F** 40 x 3 mm Plastic dividing strips: set between different floor finishes
  - Quantity: m
  - Rate: 184

- **G** Plastered walls
  - Quantity: m²
  - Rate: 1,167

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17/06/2020
## PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

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<tr>
<td>A</td>
<td>m²</td>
<td>461</td>
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<tr>
<td>B</td>
<td>m²</td>
<td>280</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>m</td>
<td>202</td>
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</tr>
<tr>
<td>D</td>
<td>m²</td>
<td>461</td>
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**CEILING FINISHES**

15 mm Lime plaster: steel finish: to concrete: to

A. Horizontal soffits

Suspended heavy gauge PVC ceiling: taper and fitted joints; on and including proprietary timber bandering system, all bulkheads: cutting and trimming to light fittings

B. Horizontal Ceiling

C. 50 x 20 mm pvc cornice

Prepare and apply three coats 1st grade plastic emulsion paint: to

D. Plastered soffits

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**Carried to Collection**

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Element No. 9
INTERNAL FINISHES
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Section No. 3
TUITION BLOCK TYPE 02
Element No. 9
INTERNAL FINISHES
170
M&A

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## PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

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<td><strong>FLOOR FINISHES</strong></td>
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<tr>
<td>Cement and sand (1:4) trowelled beds and pavings: on concrete: to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 32 mm Floors: finished to receive ceramic floor tiles</td>
<td>m²</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Non-slip Ceramic floor tiles with borders: allow for purchasing as selected by the Architect: take delivery: transport to site, store and lay: bedded on cement and sand screed measured separately: jointed and grouted in coloured imported proprietary grout:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B 300 x 300 x 10 mm Floor tiles</td>
<td>m²</td>
<td>16</td>
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<td><strong>WALL FINISHES</strong></td>
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<tr>
<td>12 mm Cement and sand (1:4) render: wood float finish: on concrete or stonework: to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Wall surfaces</td>
<td>m²</td>
<td>424</td>
<td></td>
</tr>
<tr>
<td>D Ring Beam surfaces</td>
<td>m²</td>
<td>69</td>
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<tr>
<td>Prepare and apply one undercoat and two finishing coats 'Matt' Emulsion paint on cement and sand backing render (ms)</td>
<td></td>
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<tr>
<td>E Rendered surfaces</td>
<td>m²</td>
<td>493</td>
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<td><strong>CEILING FINISHES</strong></td>
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<tr>
<td>Suspended heavy gauge PVC ceiling: taper and fitted joints: on and including proprietary timber brandering system, all bulkheads: cutting and trimming to light fittings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Horizontal Ceiling</td>
<td>m²</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>G 50 x 20 mm pvc cornice</td>
<td>m</td>
<td>17</td>
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Section No. 3
TUITION BLOCK TYPE 02
Element No. 10
EXTERNAL FINISHES
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M&A

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<td>ELEMENT NO. 11</td>
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<td>BWIC MECHANICAL &amp; ELECTRICAL INSTALLATIONS</td>
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<tr>
<td></td>
<td>Builders work in connection with plumbing installations</td>
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<tr>
<td></td>
<td>Cut away for sanitary fittings and pipework : form all holes, chases, etc, and make good after the plumber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>W.C. suite</td>
<td>No</td>
<td>21</td>
</tr>
<tr>
<td>B</td>
<td>Wash hand basin</td>
<td>No</td>
<td>12</td>
</tr>
<tr>
<td>C</td>
<td>Stainless steel urinal : 4000 mm long</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>Towel rail</td>
<td>No</td>
<td>12</td>
</tr>
<tr>
<td>E</td>
<td>Soap Tray</td>
<td>No</td>
<td>12</td>
</tr>
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<td>F</td>
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<td>Water storage tank : 2500 LTRS</td>
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<td>Builders Work in Connection with Electrical Installations</td>
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<td>Provide the Provisional Sum of KShillings Fifty Thousand Only (KShs 50,000/-) for Builders Work in Connection with Electrical Installations</td>
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**Carried Forward to Summary of Section No. 3**

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Section No. 3  
TUITION BLOCK TYPE 02  
Element No. 11  
BWIC MECHANICAL & ELECTRICAL INSTALLATIONS  
170  
M&A
## SECTION SUMMARY - TUITION BLOCK TYPE 02

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**Carried to Final Summary**

Section No. 3
TUITION BLOCK TYPE 02
170
M&A

**Amount**

KSHS
MAIN SUMMARY
PROPOSED TUITION BLOCK TYPE 02
FOR KENYA MEDICAL TRAINING COLLEGE

FINAL SUMMARY

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<th>SPECIFICATIONS</th>
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CONTINGENCY SUM

Sub total

ADD VAT .... %

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Carried to Form of Tender

170
M&A